

The diagram illustrates a digital-to-analog converter (DAC) architecture. It features two parallel processing paths for inputs  $I$  and  $Q$ . Each path includes a 'Sqrt Nyquist Filter', a  $x/\sin x$  block, a 'D/A' block, and an 'LPF' block. The outputs of the LPFs are multiplied by  $\cos 2\pi f_c t$  and  $\sin 2\pi f_c t$  respectively. The final outputs are summed to produce the reconstructed analog signal.

Figure 1A A simplified PSK transmitter.

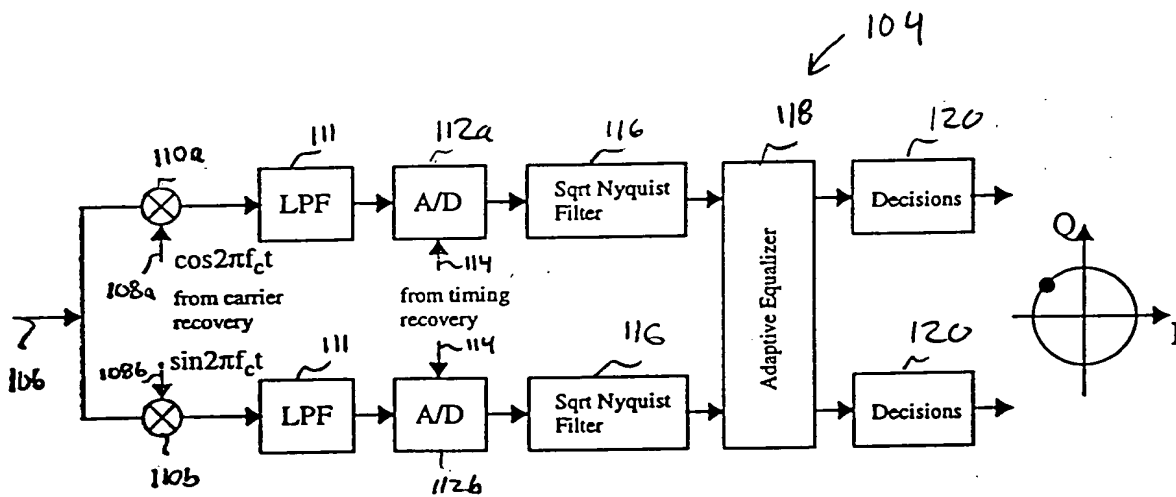


Figure 10 A simplified PSK receiver.

126

Figure 1c Simplified block diagram of an OFDM system.

Figure 10 PSK receiver with carrier and timing recovery.

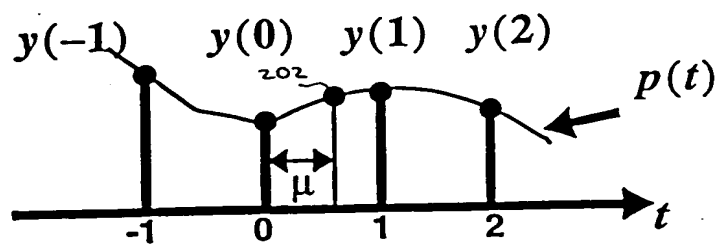
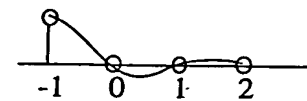
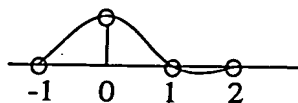


Figure 2 Interpolation Environment

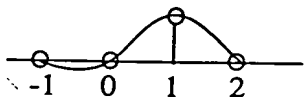
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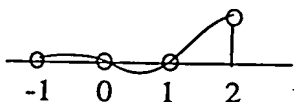
$$C_{-1}(\mu) = -\frac{1}{6}\mu^3 + \frac{1}{2}\mu^2 - \frac{1}{3}\mu$$



$$C_0(\mu) = \frac{1}{2}\mu^3 - \mu^2 - \frac{1}{2}\mu + 1$$



$$C_1(\mu) = \frac{1}{2}\mu^3 + \frac{1}{2}\mu^2 + \mu$$



$$C_2(\mu) = \frac{1}{6}\mu^3 - \frac{1}{6}\mu$$

Figure 3 The Lagrange basis polynomials.

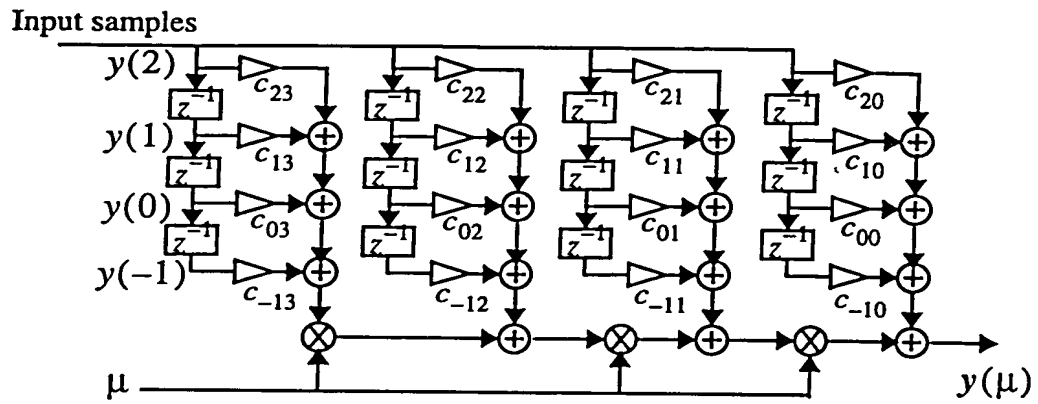


Figure 4 The Farrow structure that implements (2.5) and (2.6).

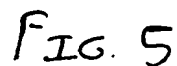
[illegible]

FIG. 6A

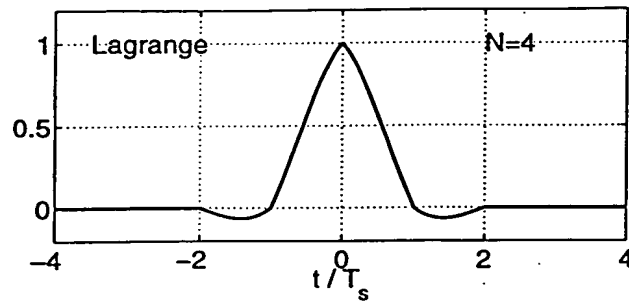


FIG. 6B

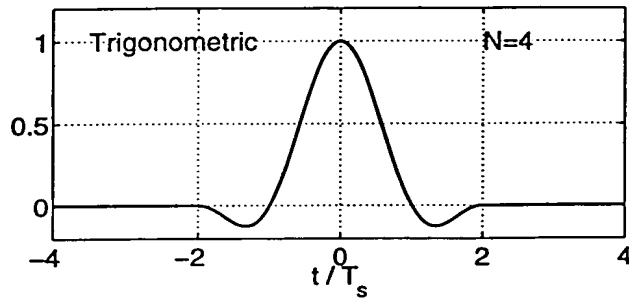


FIG. 6A-6B Impulse responses of (a) Lagrange interpolator and (b) Trigonometric interpolator.

[illegible]

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FIG. 7A

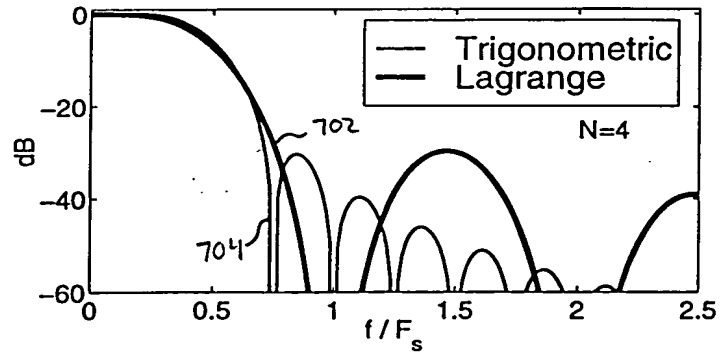


FIG. 7B

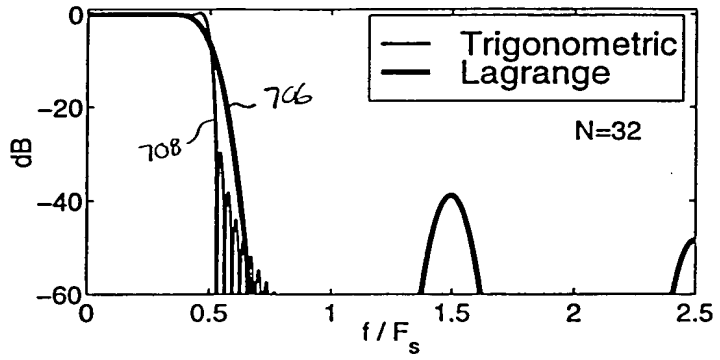


FIG. 7A-7B: Frequency responses for (a)  $N=4$  and (b)  $N=32$ .

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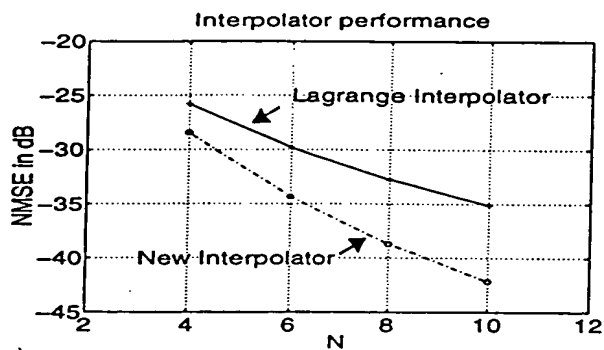


Figure 8B NMSE of the interpolated signal.

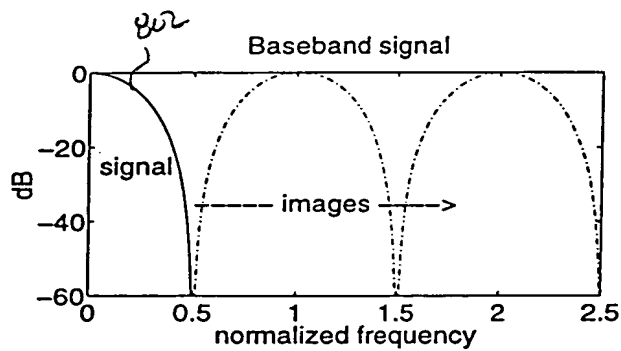


Figure 8A Signal with two samples/symbol and 100% excess BW.

Figure 9 The critical path of the Lagrange cubic interpolator.

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1000

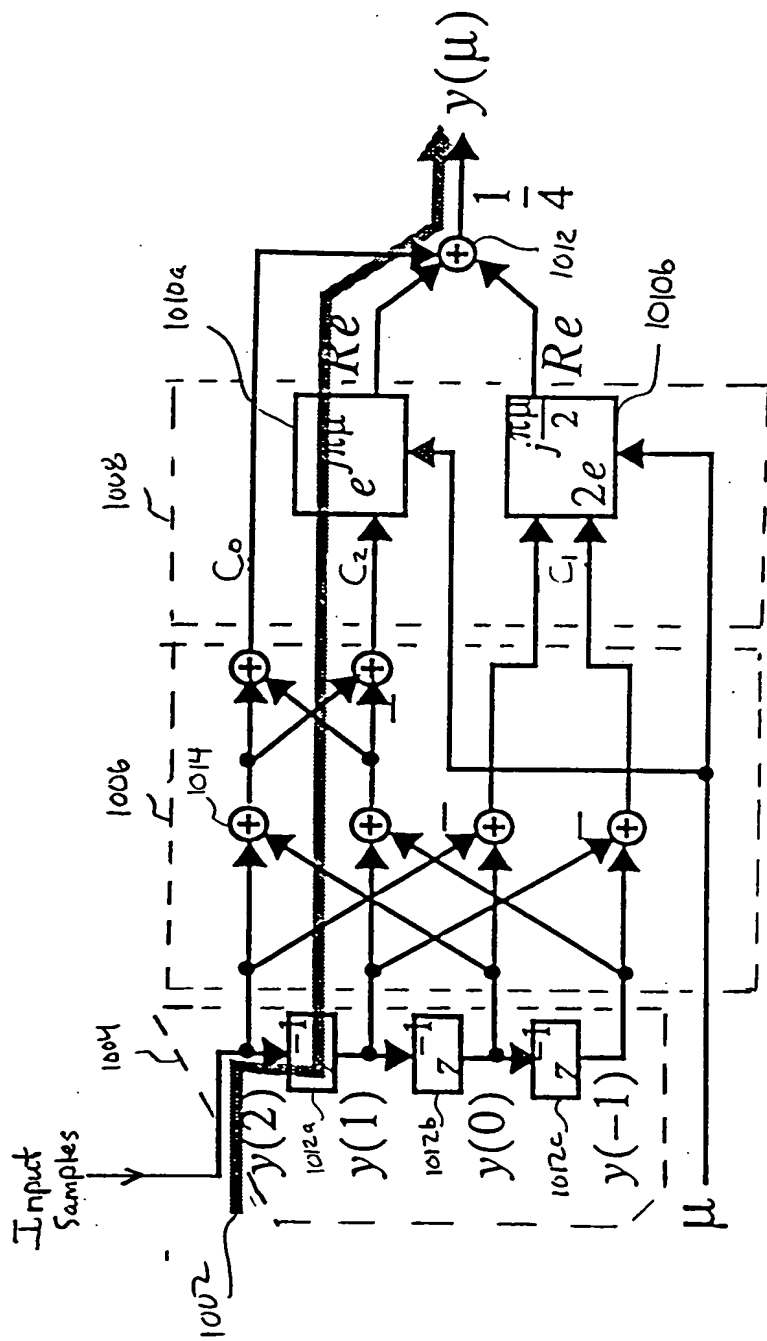


FIG. 10% Trigonometric Interpolator (N=4)

1100

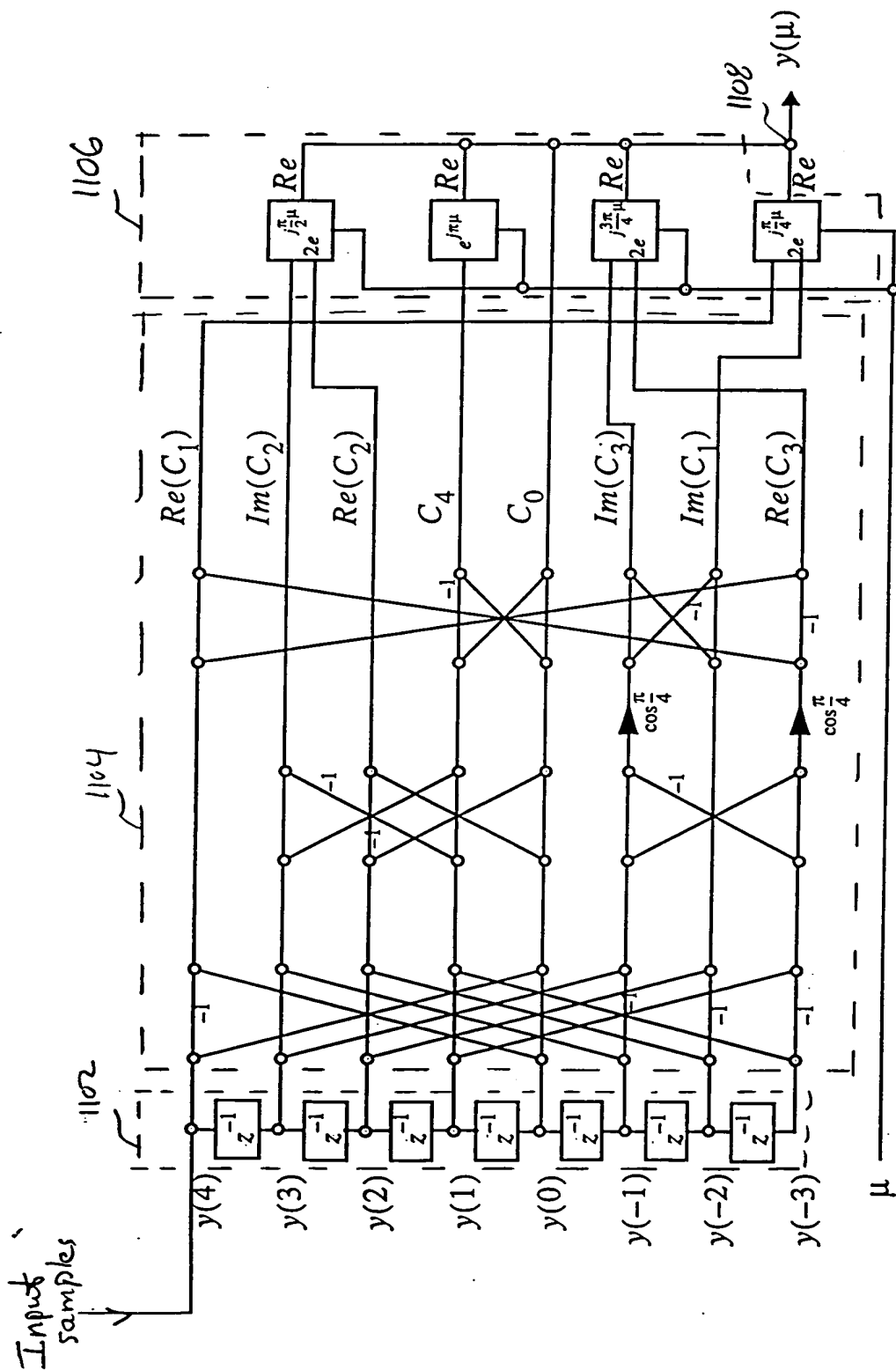


Figure 11 Trigonometric Interpolator with  $N=8$ .

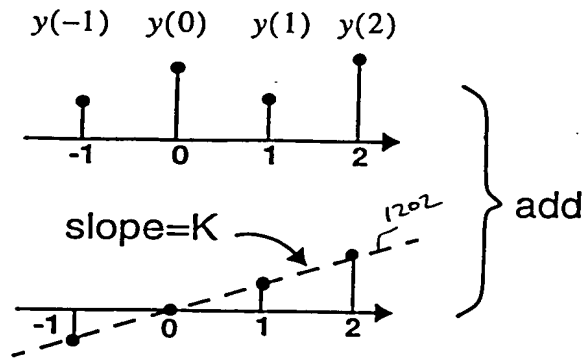


Figure 12 Conceptual modification of input samples.

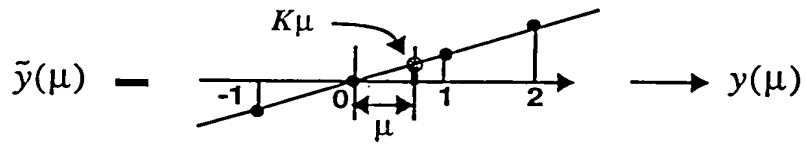


Figure 13 Correcting the offset due to modification of original samples.

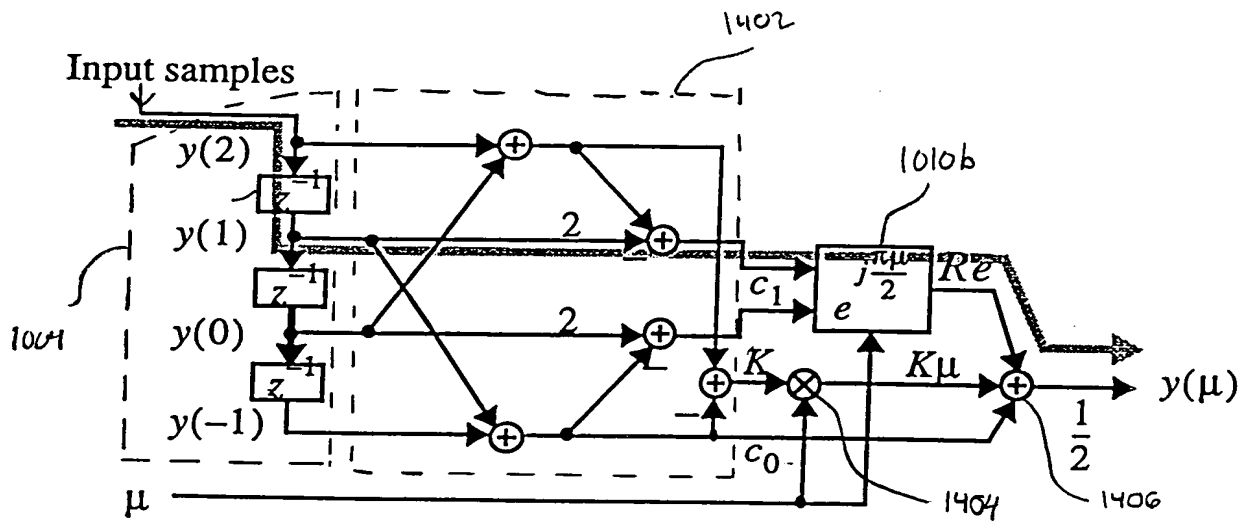


FIG. 14: Trigonometric Interpolator  $N=4$

1500



1506

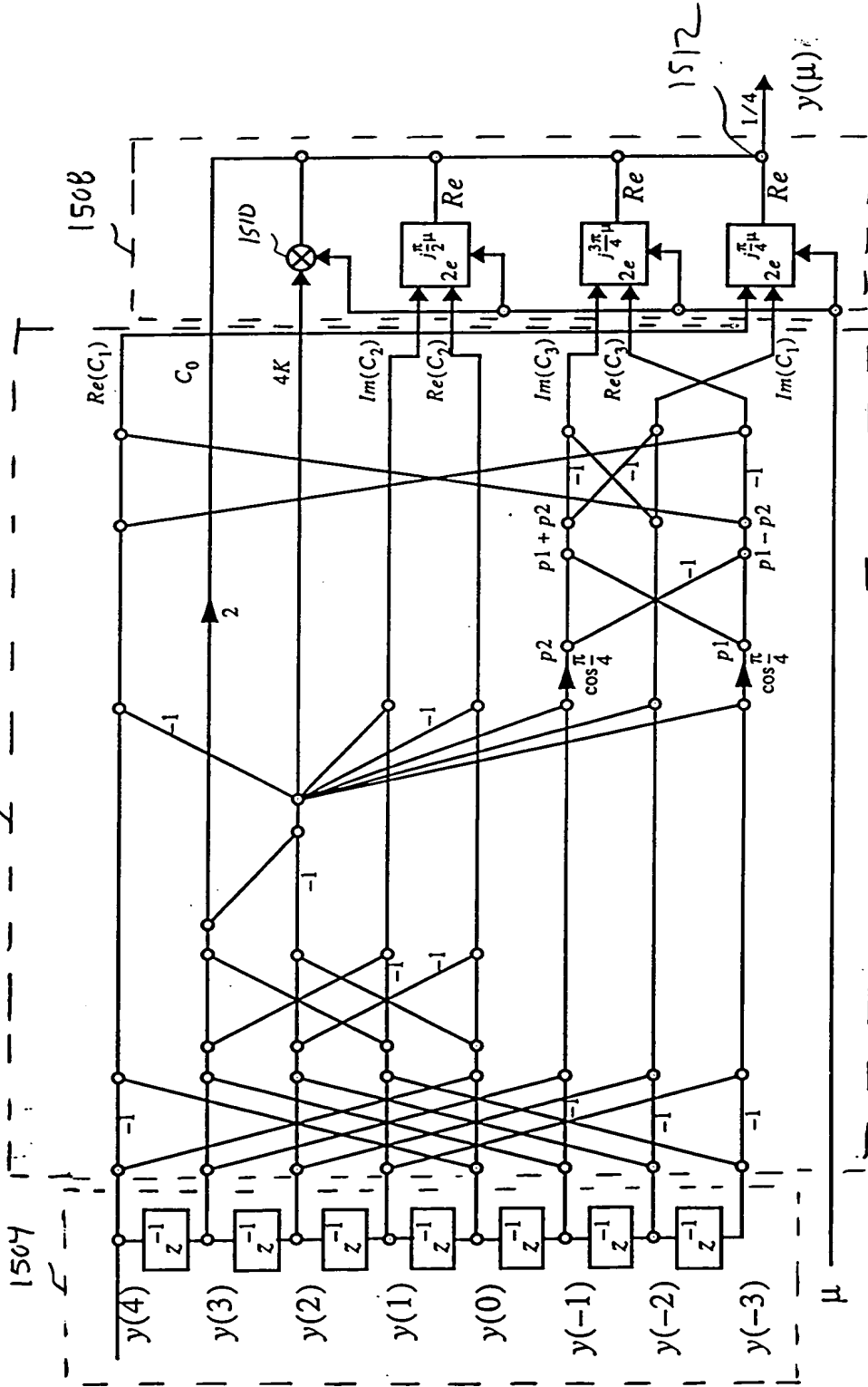


FIG. 15 The modified Trigonometric Interpolator

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Interpolation errors are shown in gray.

FIG. 16A: Lagrange cubic

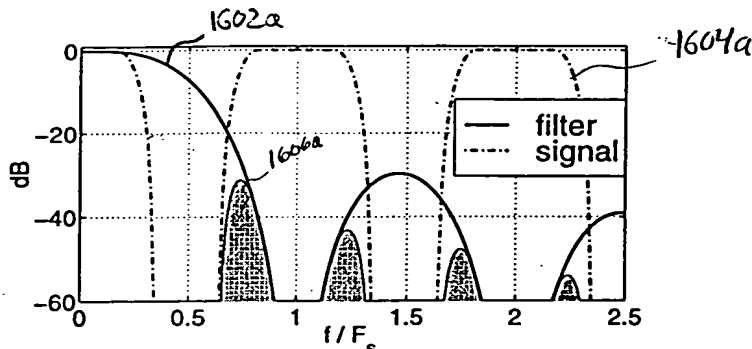


FIG. 16B: Trigonometric Interpolator 1000 (FIG. 10)

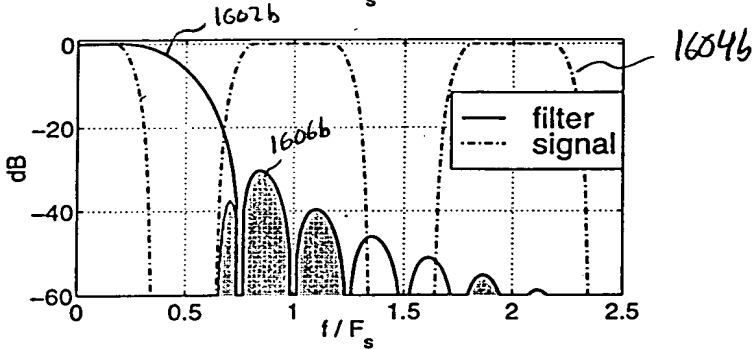


FIG. 16C: Trigonometric Interpolator 1400 (FIG. 14)

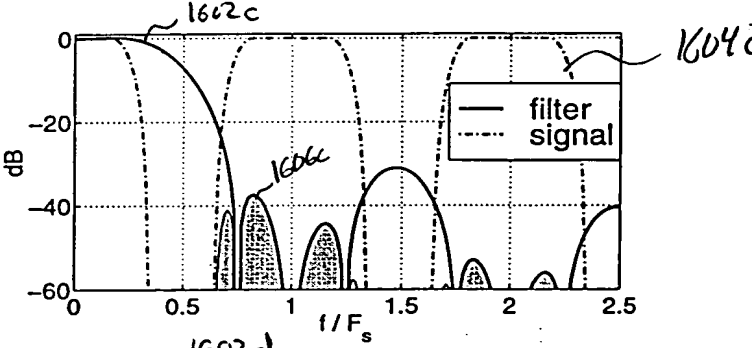
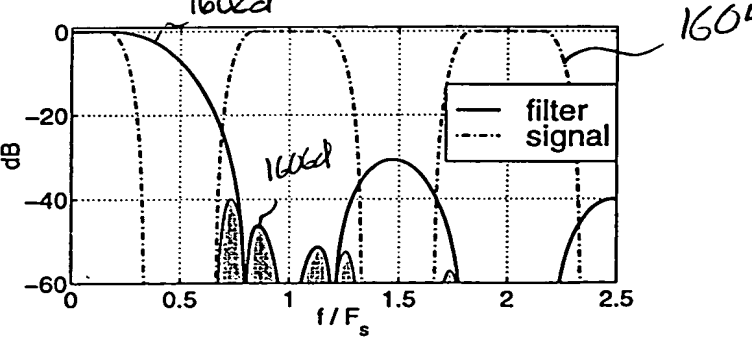


FIG. 16D: Optimal structure



1700

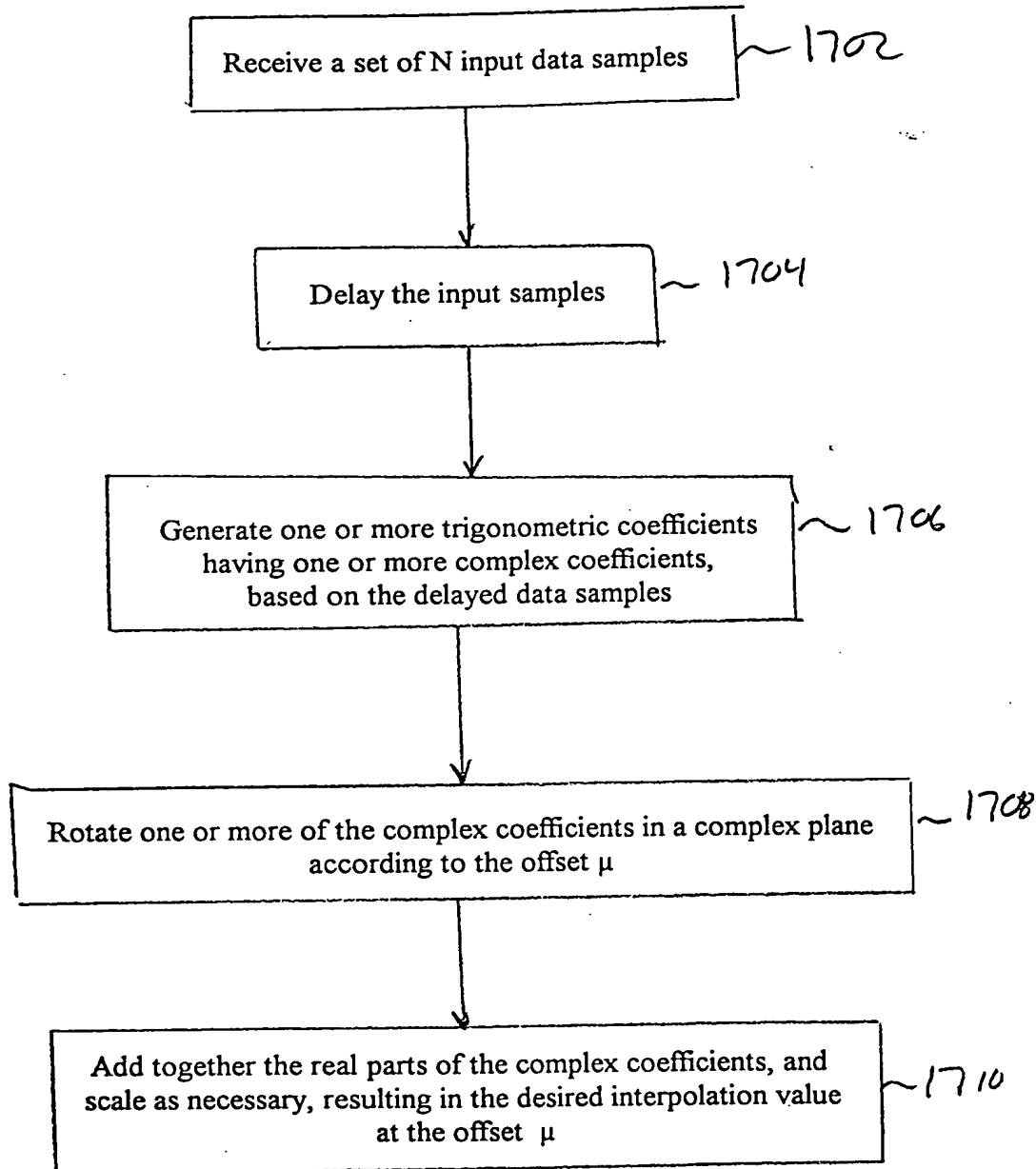
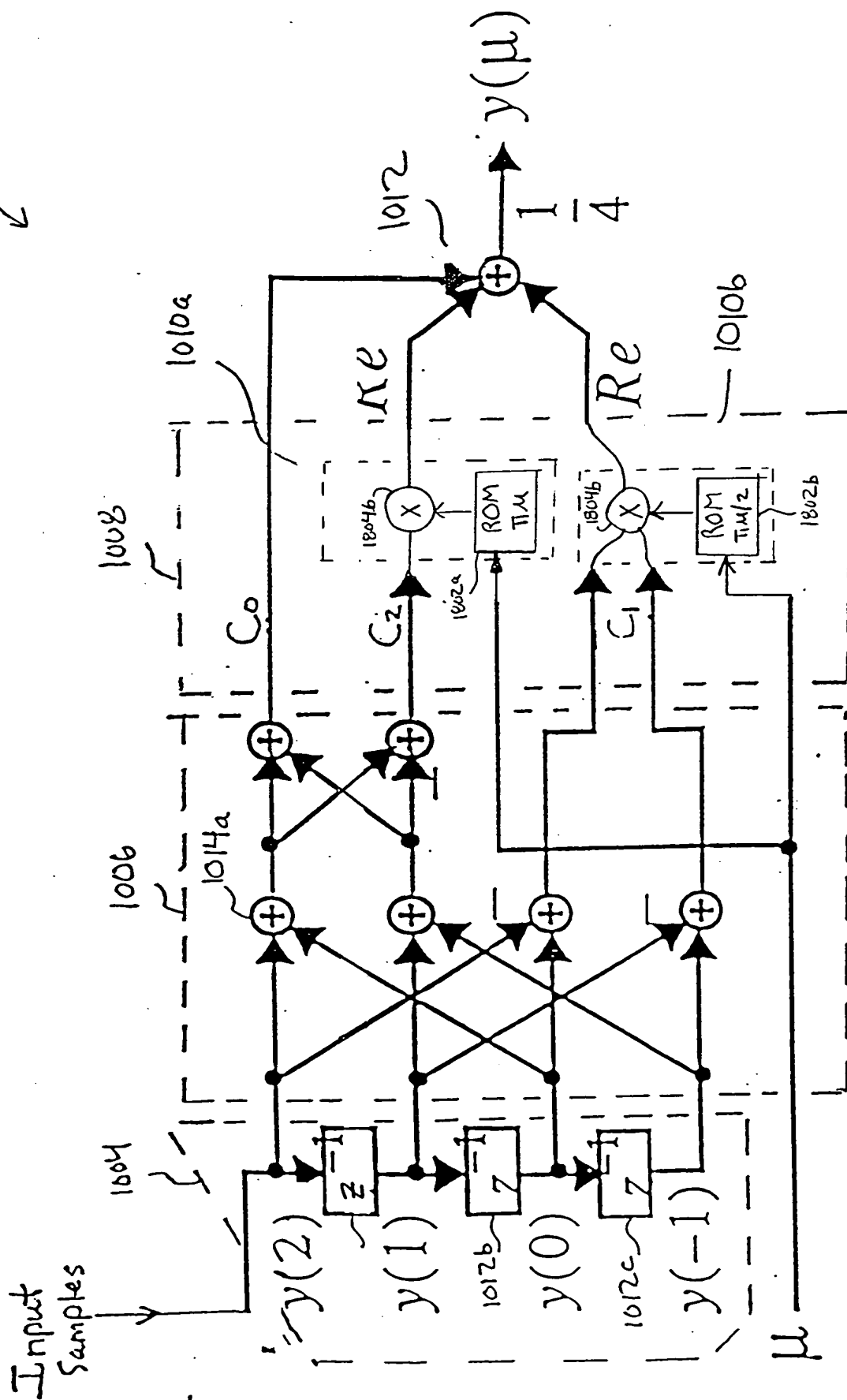


FIG. 17



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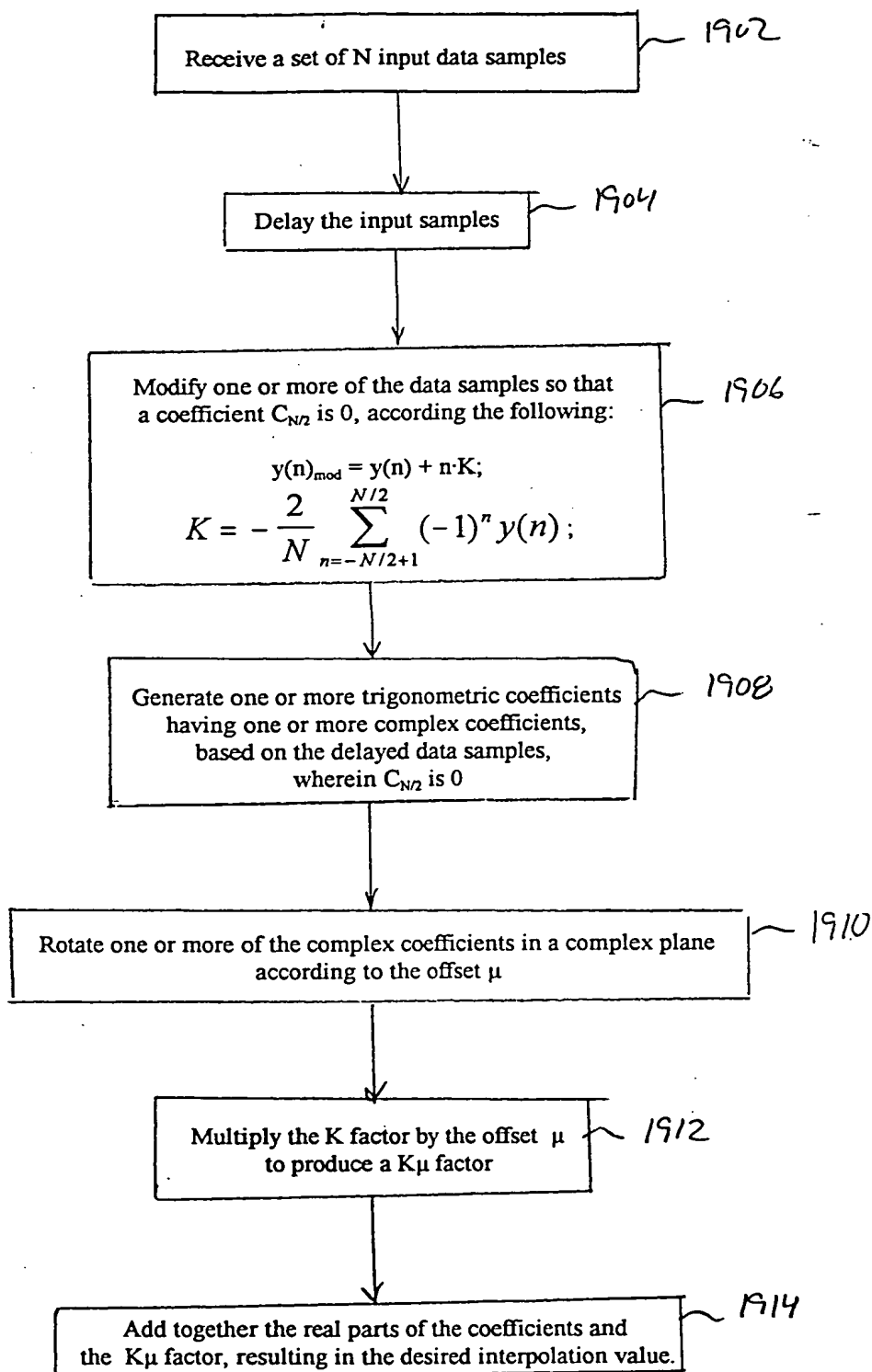


FIG. 19

00000000000000000000000000000000

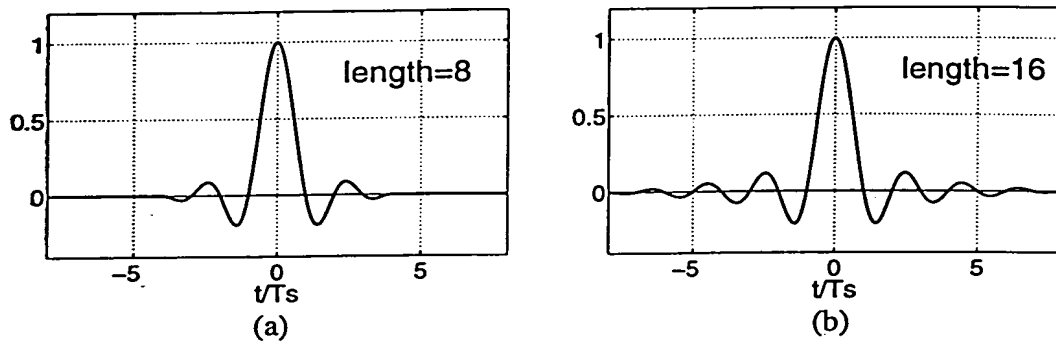


FIG.20: Normalized Impulse responses  $f$  of the interpolation filters.

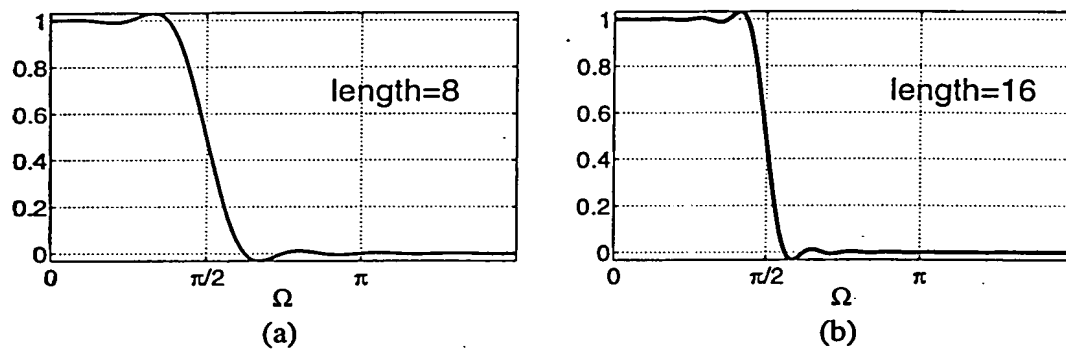


FIG.21: Normalized Frequency responses  $F$  of the interpolation filters.

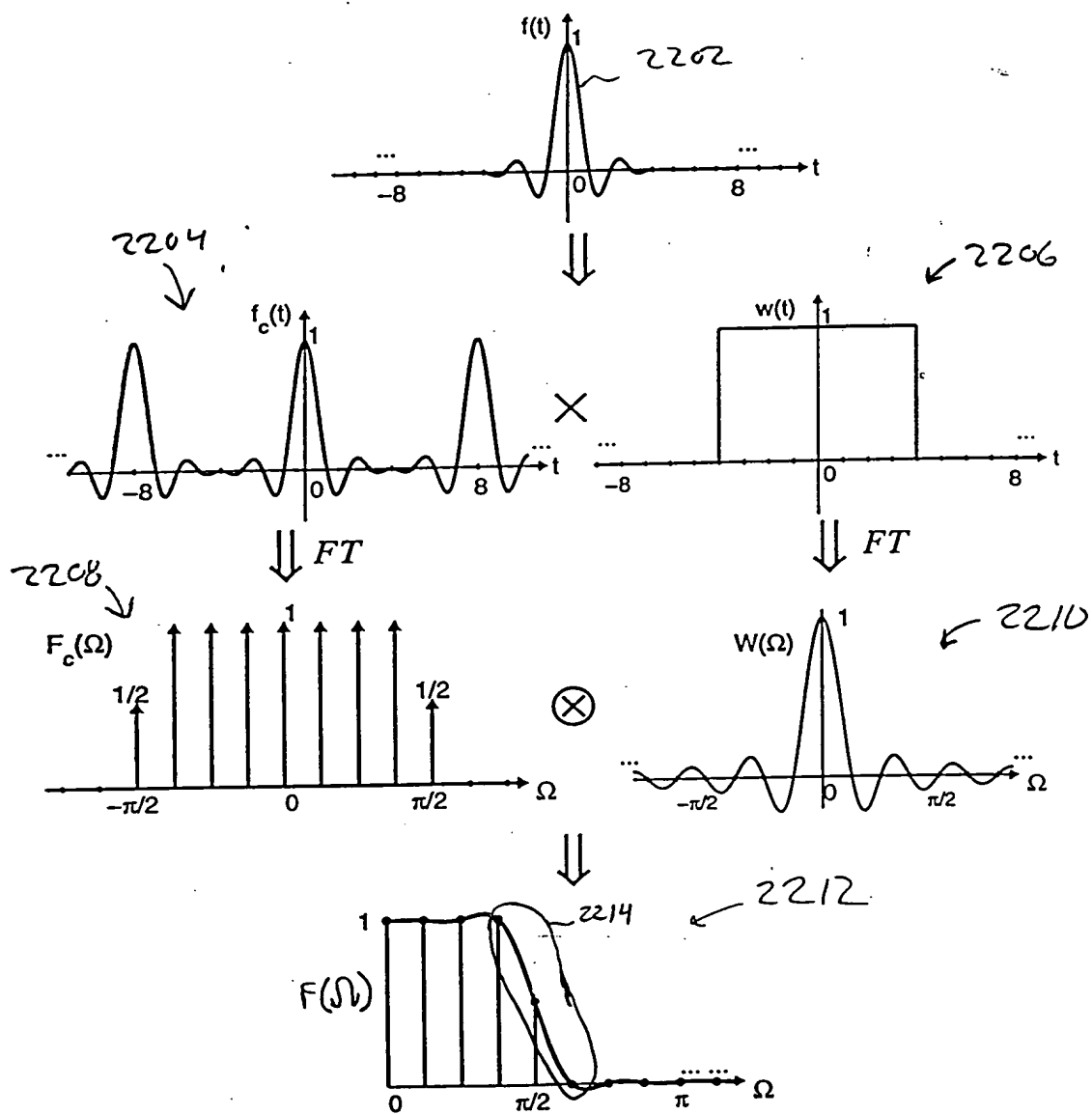


FIG.22 : Analysis of the frequency responses.

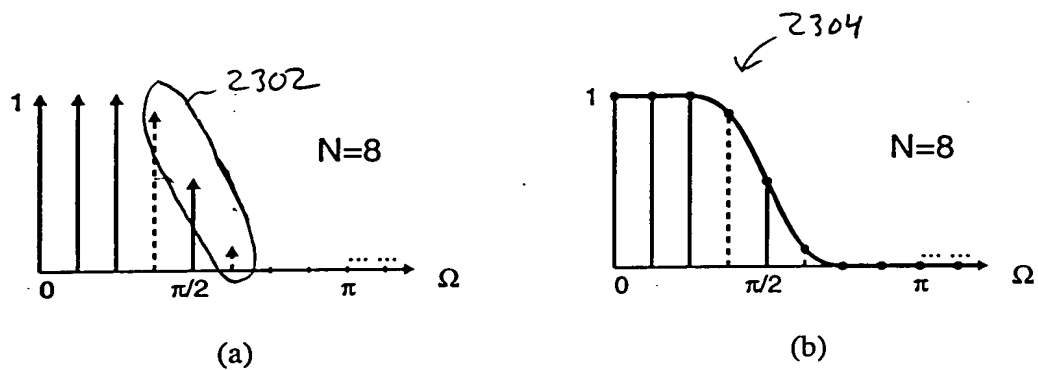


FIG.23 Effect of a more gradual transition at the band edge.

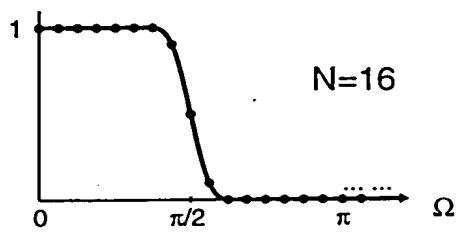


FIG.24 Reducing the transition bandwidth by increasing  $N$ .

3-4b, in which  $N = 8$ .

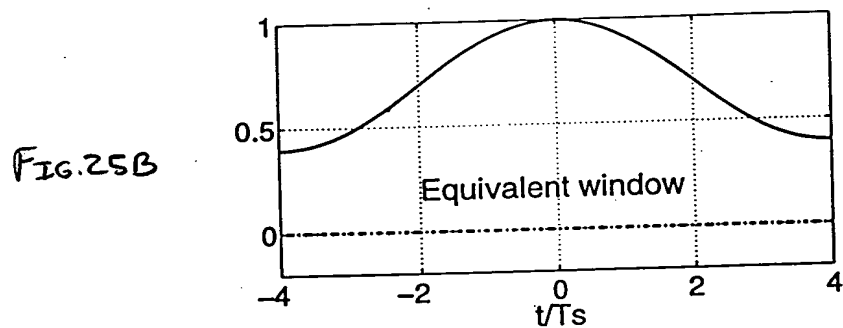
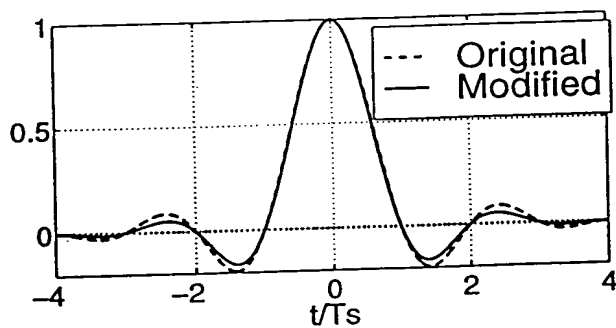


FIG. 25A-B: (A) Impulse response of the original filter and the modified filter: (B) The equivalent window.

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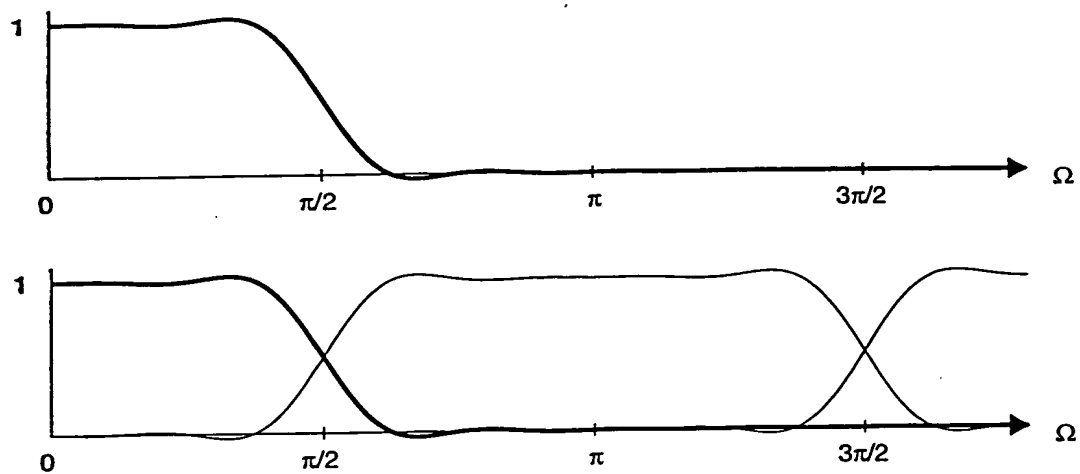


FIG. 26 Forming the frequency response of the discrete-time fractional-delay filter.

FIG. 27A

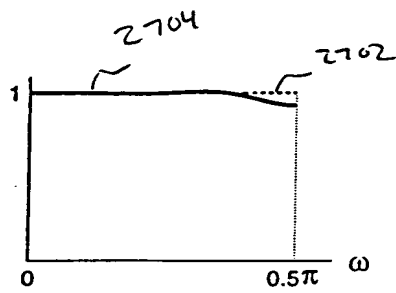


FIG. 27B

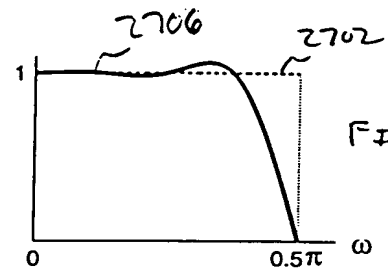


FIG. 27A-B: Fractional-delay filter with (A)  $\mu=0.12$  and (B)  $\mu=0.5$ , using the preliminary  $N=8$  interpolator.

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FIG. 28A

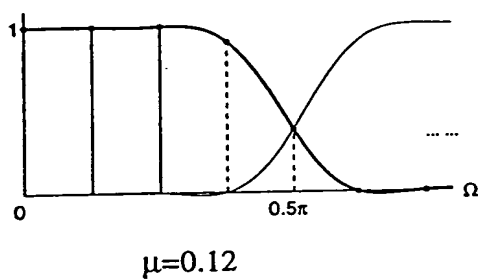


FIG. 28B

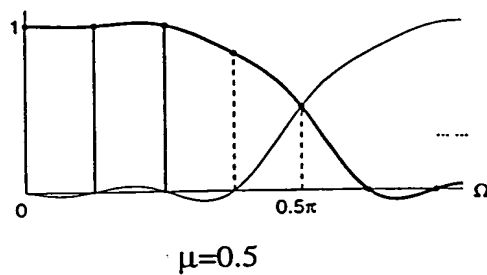


FIG. 28C

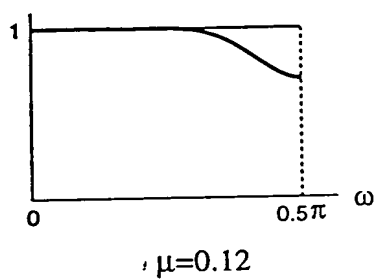
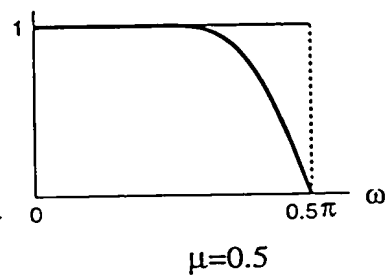


FIG. 28D



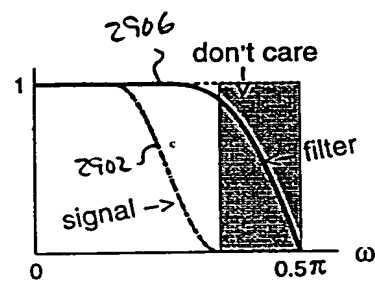
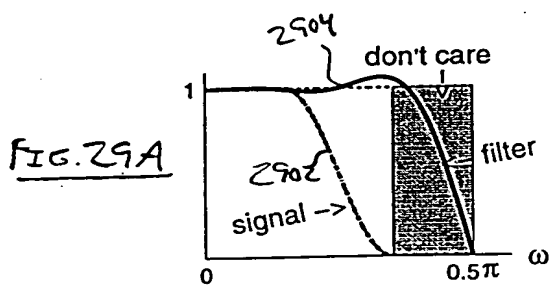


FIG. 29A-B:  $F_{\mu}(\omega)$ , with  $\mu=0.5$ ,  $N=8$ , (A) before and (B) after optimization.

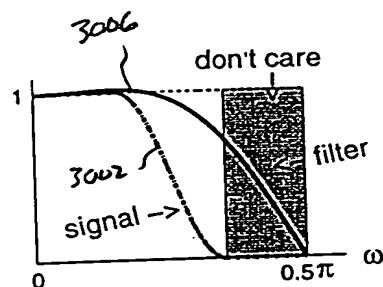
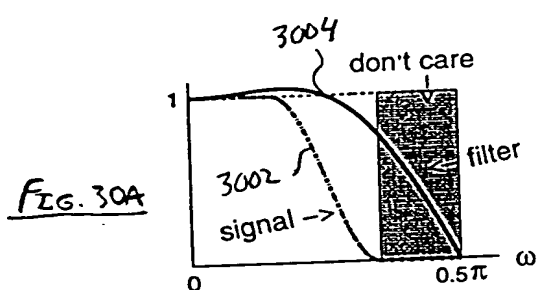


FIG. 30B

FIG. 30A-B  $F_{\mu}(\omega)$  for  $\mu=0.5$ ,  $N=4$ , A) before and B) after modification.

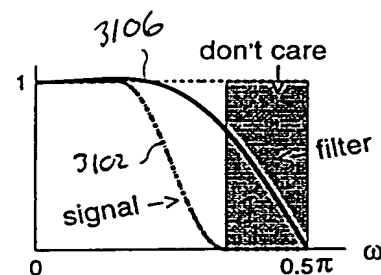


FIG. 3/A-B  $F_{\mu}(\omega)$ ,  $\mu=0.5$ , simplified  $N=4$  structure, A, before and B, after modification.

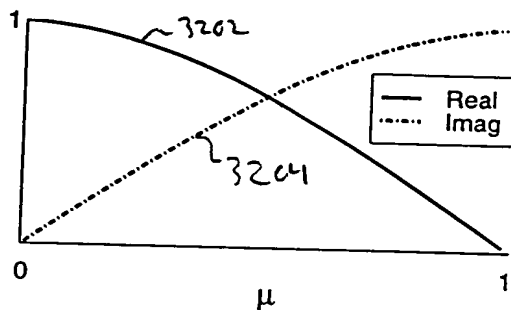


FIG.32: Real and imaginary components of the  $\hat{F}_{\mu}(1)e^{j\frac{\pi}{2}\mu}$  value.



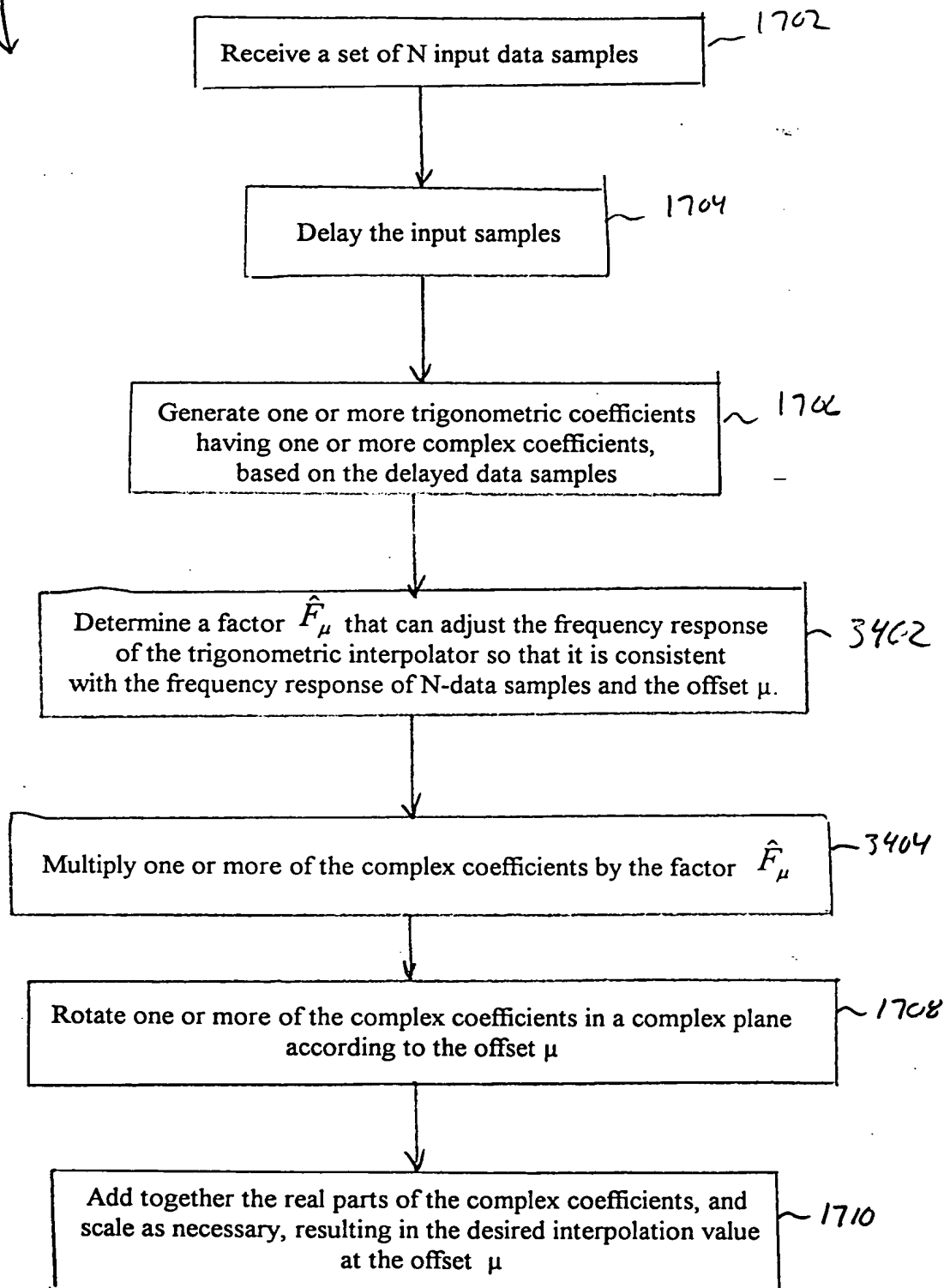


FIG. 34

**00000000000000000000000000000000**

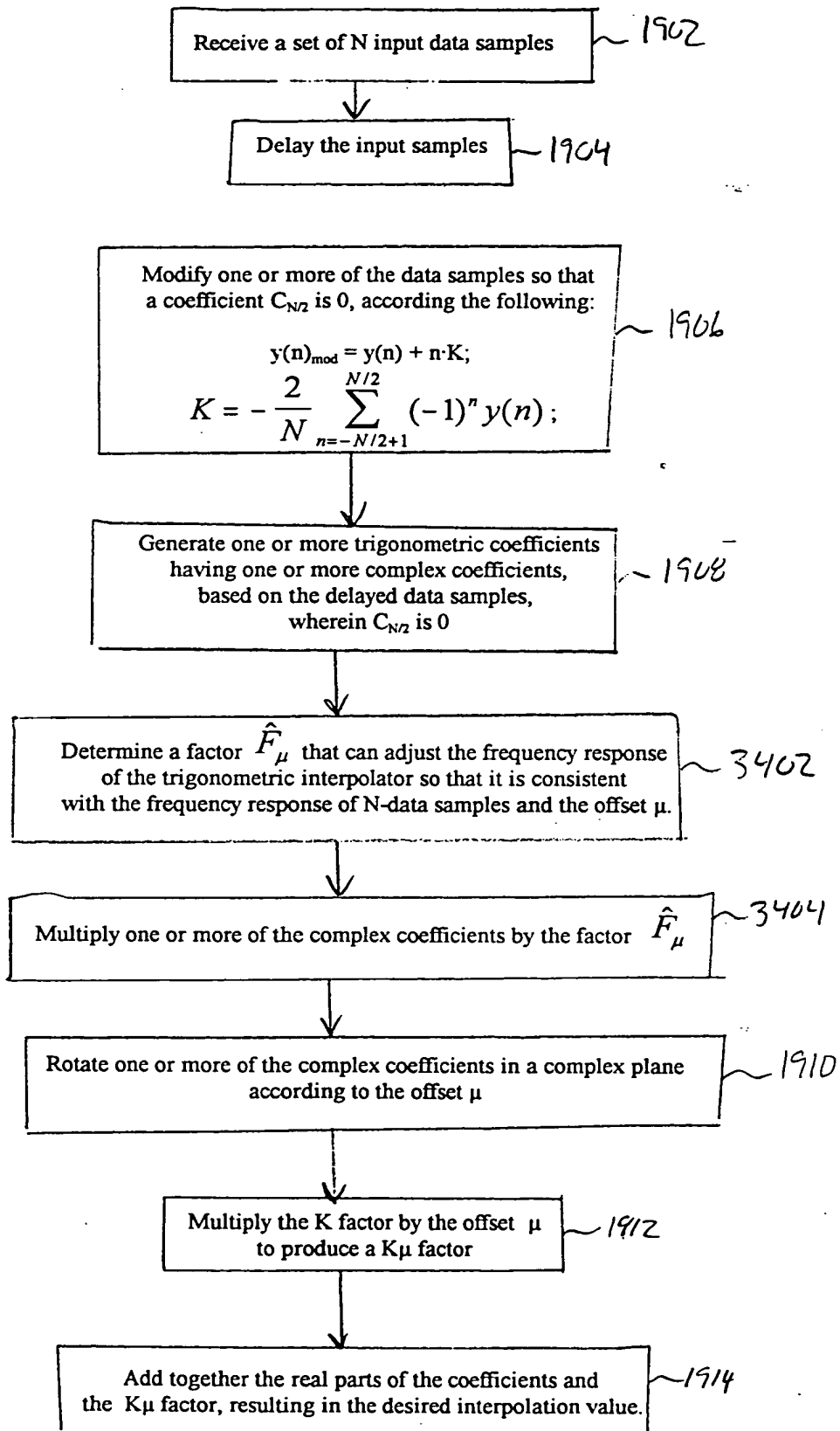


FIG. 35

3600

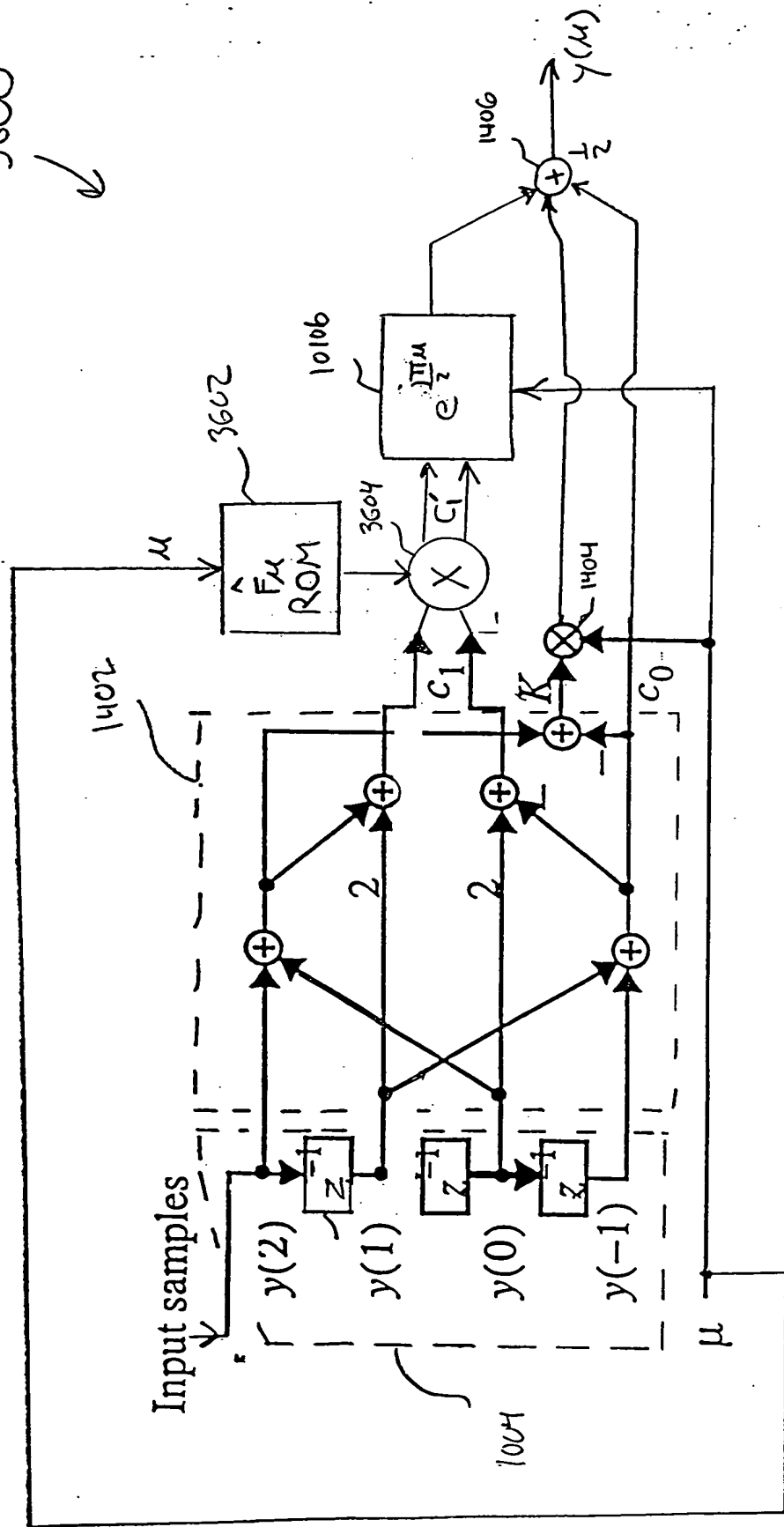


FIG. 36 The optimized structure for  $N=4$ .

3700

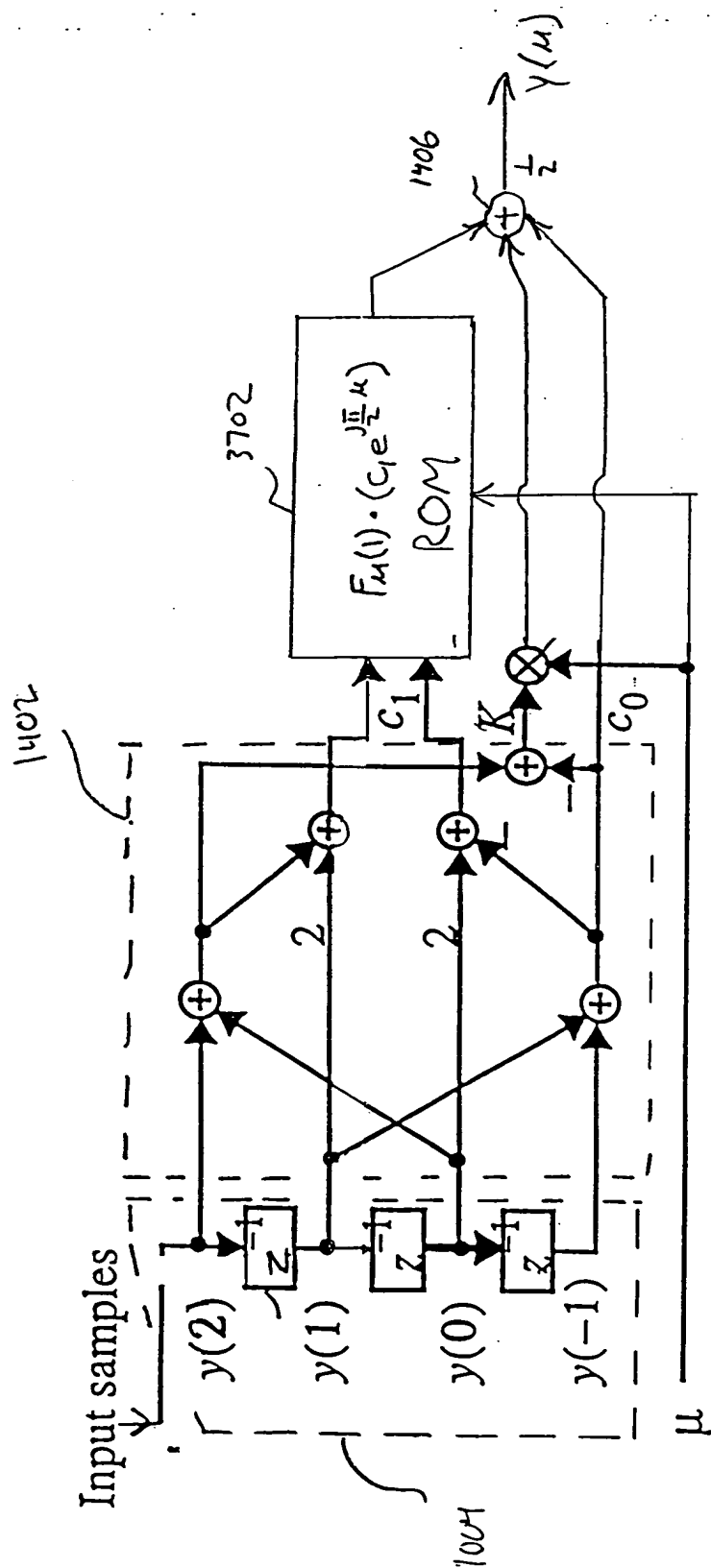


FIG. 37: The optimized structure for  $N=4$ .

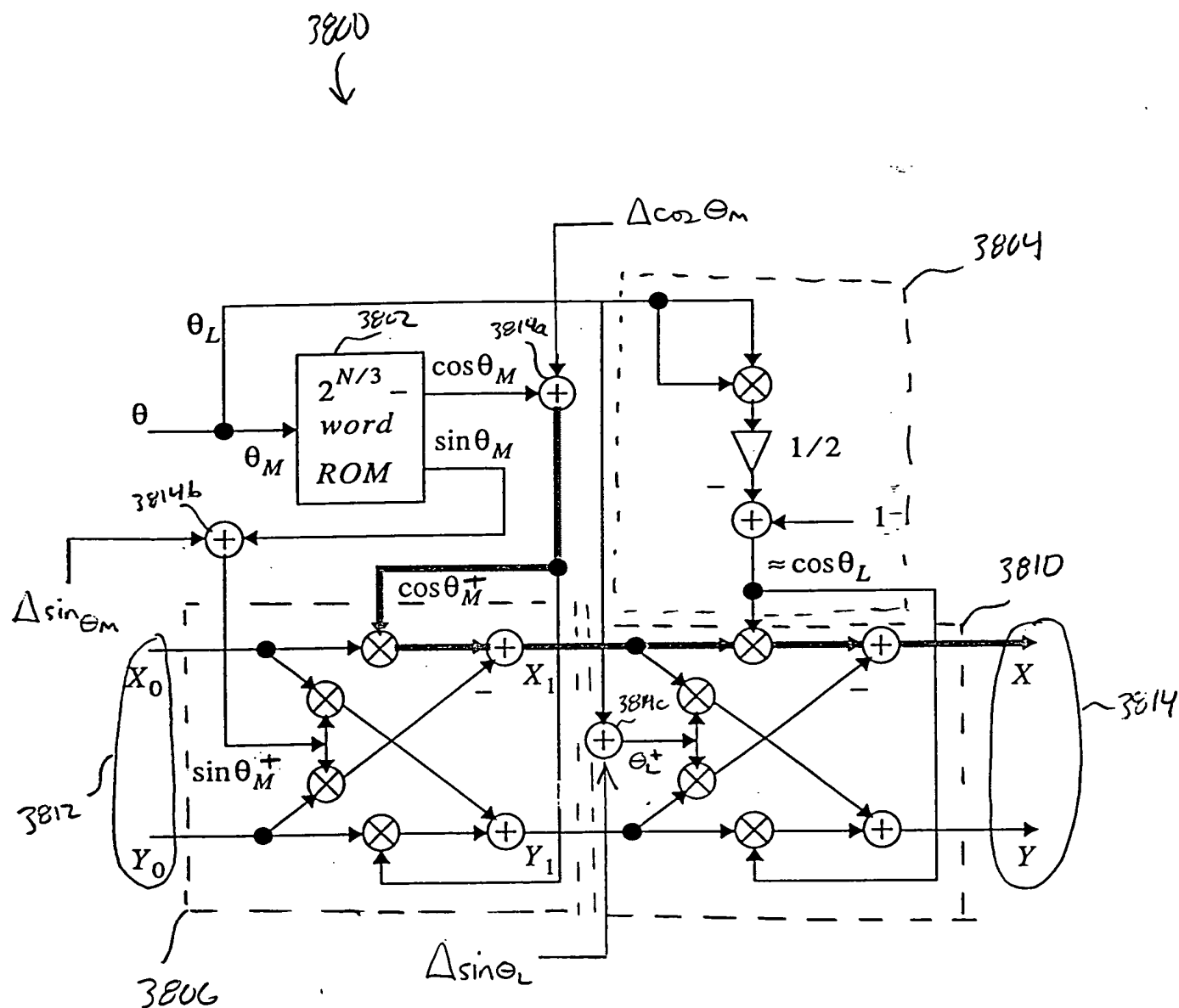


FIG. 38

3906

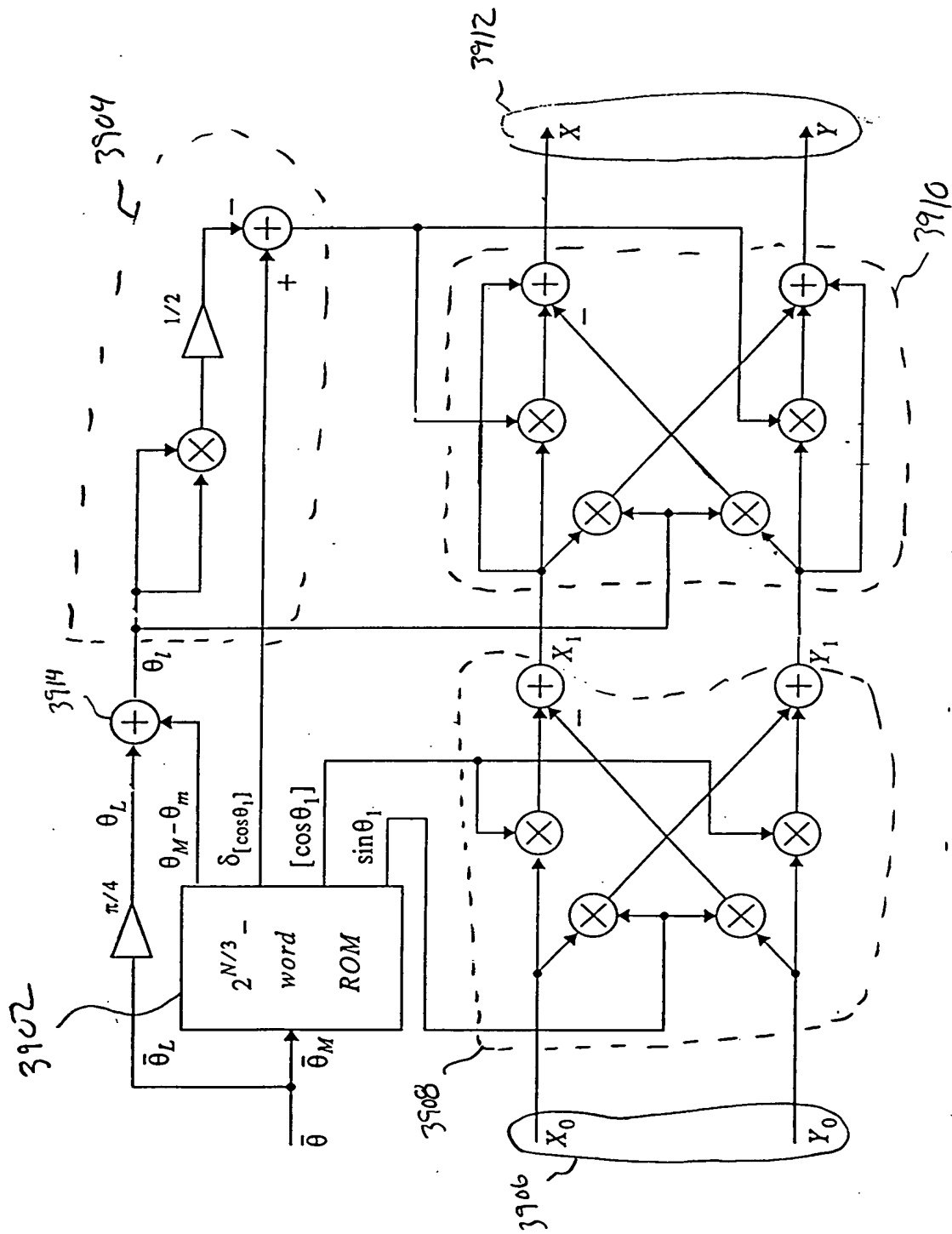


FIG. 39

3900

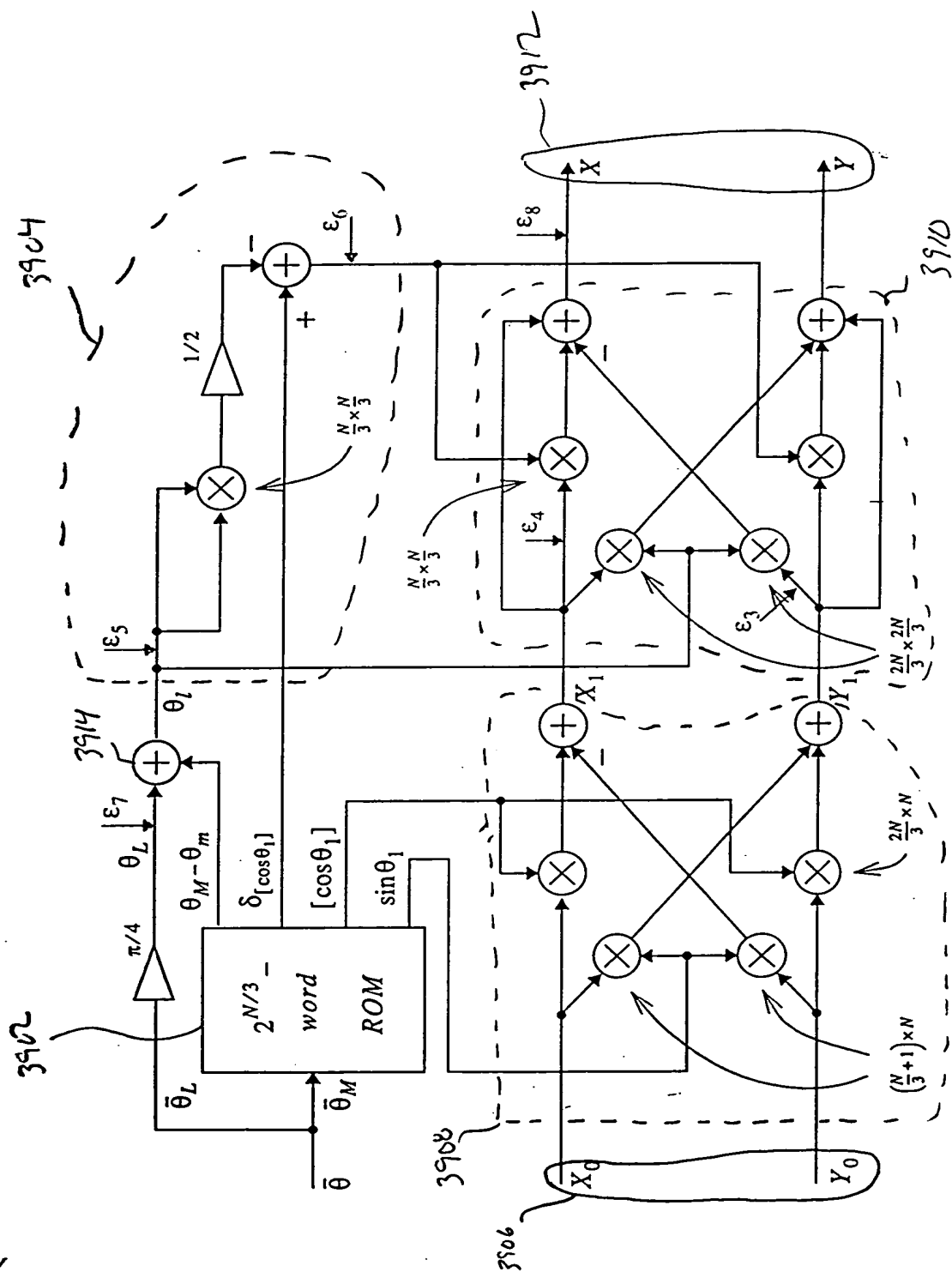


FIG. 40

4100  
↓

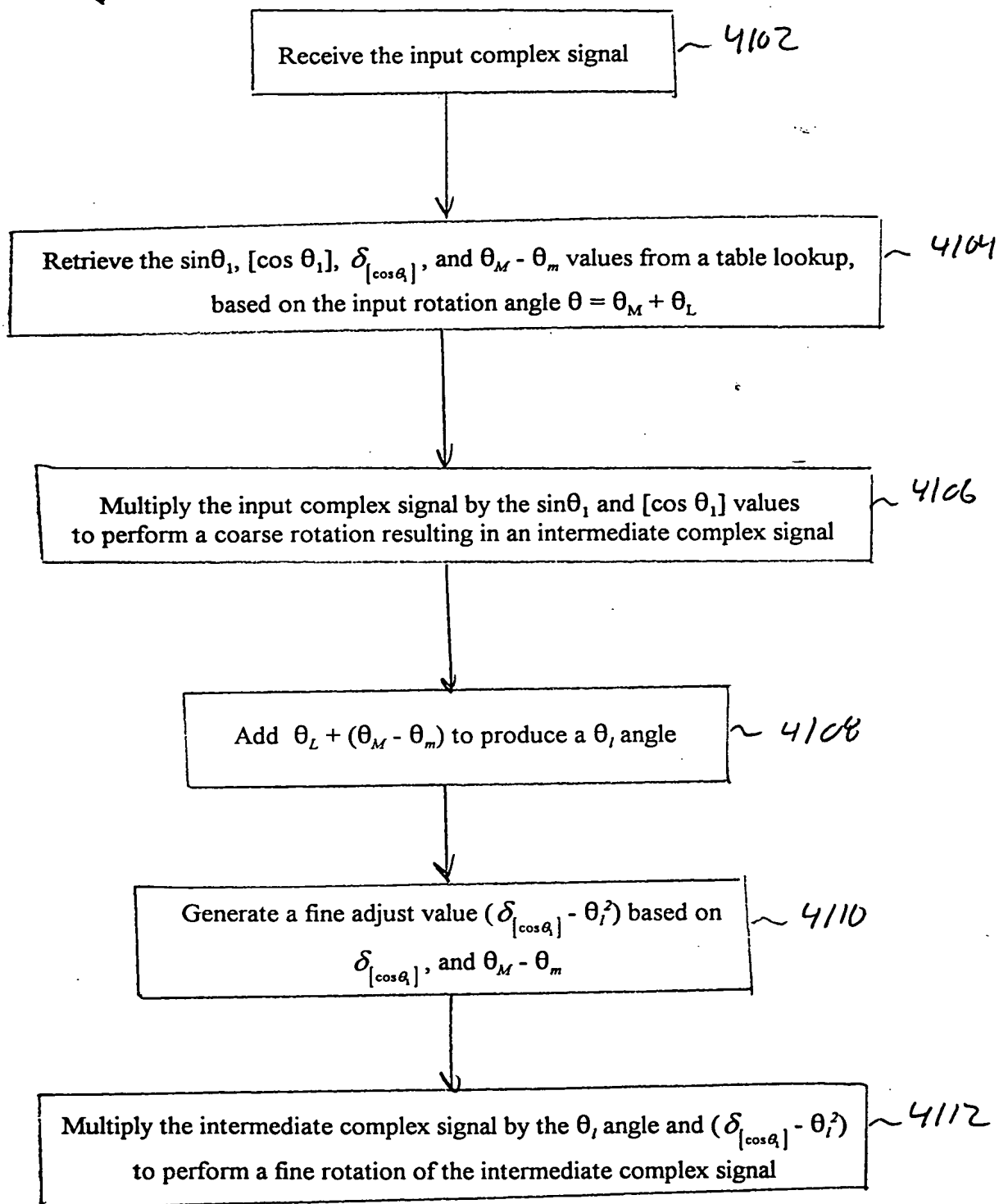


FIG. 41

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3910  
↓

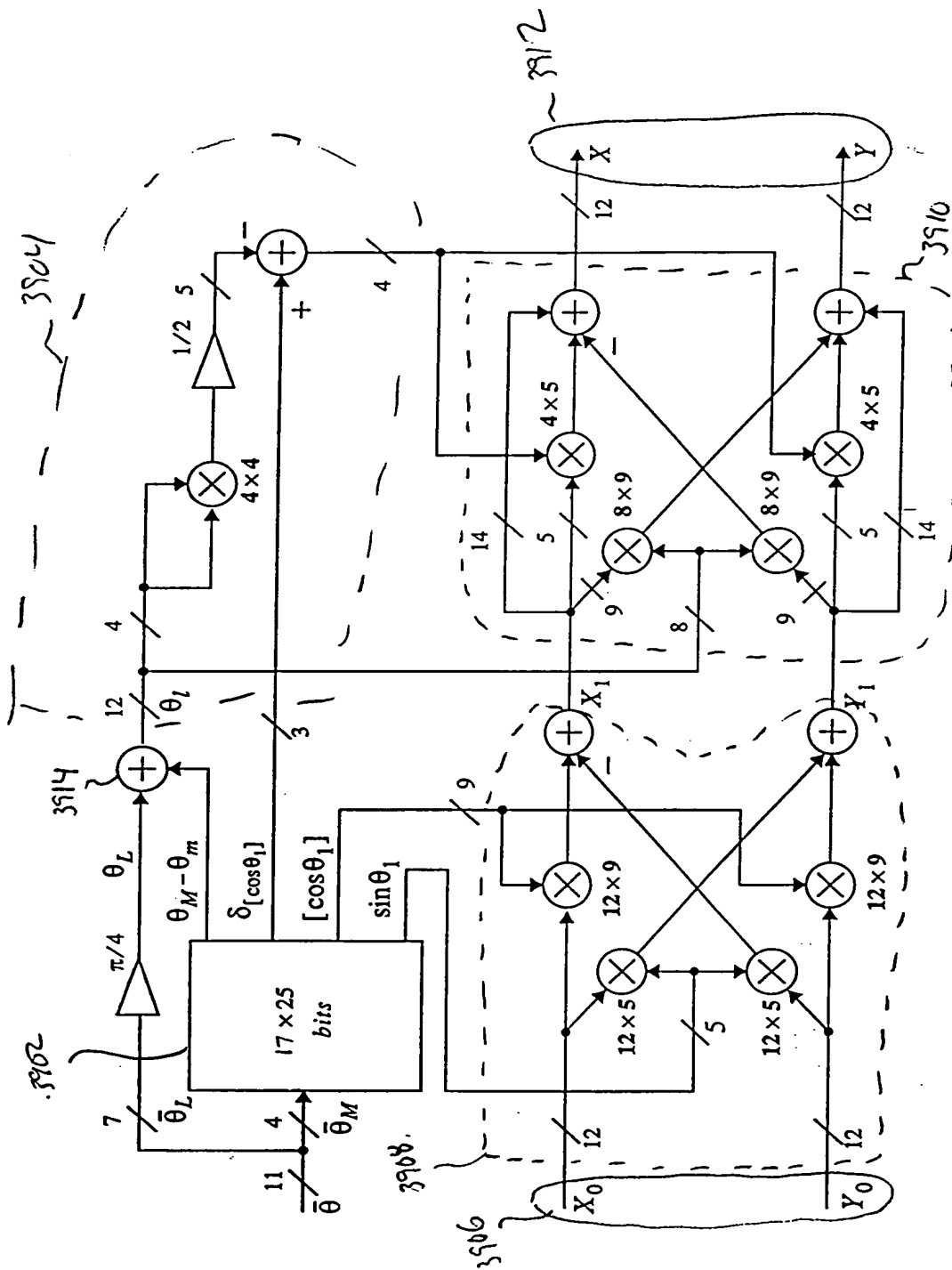


FIG. 42 The internal wordlength of the structure that achieved 90.36 dB SFDR.

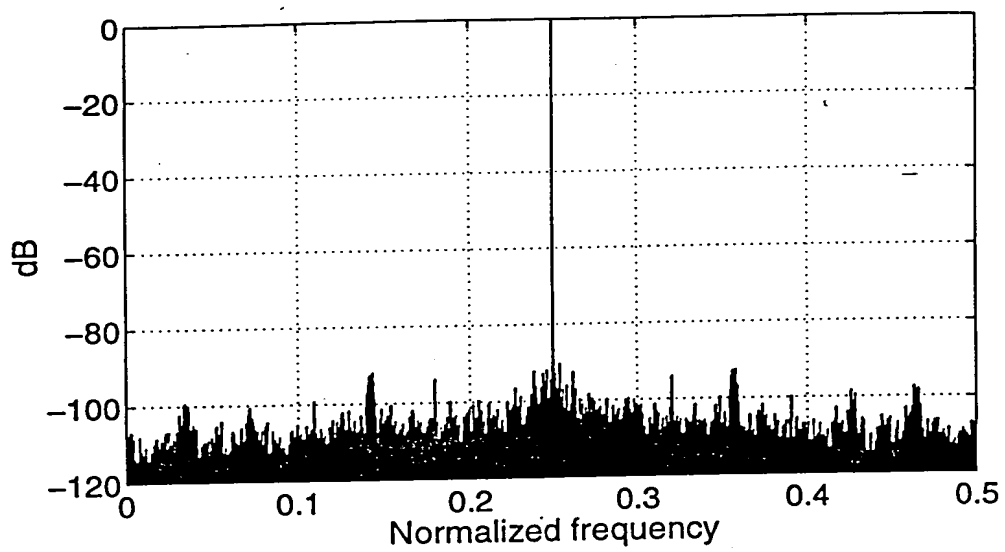


FIG.43 Output spectrum showing 90.36 dB SFDR.

4406

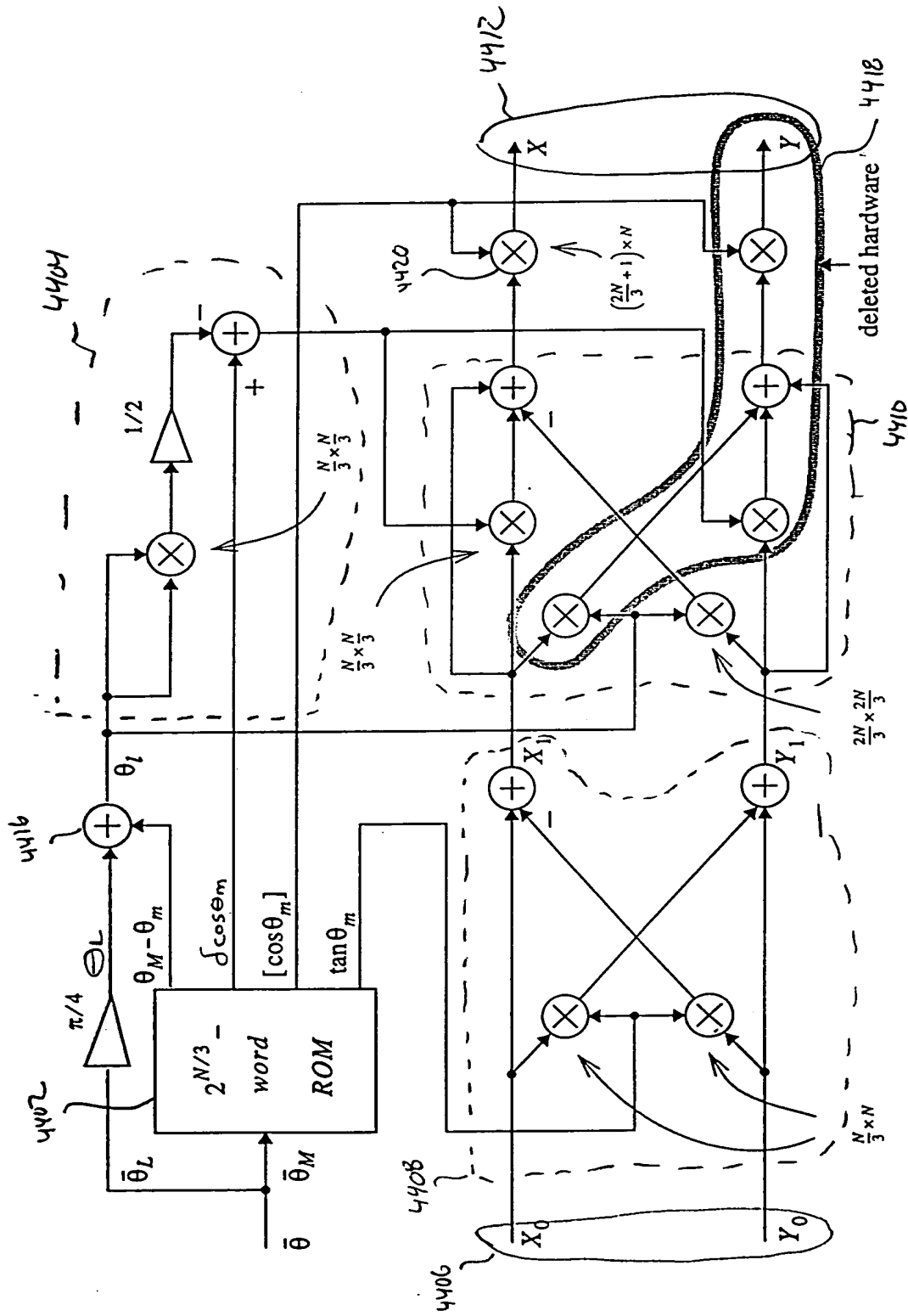


FIG. 44 A modified architecture when only one output is needed.

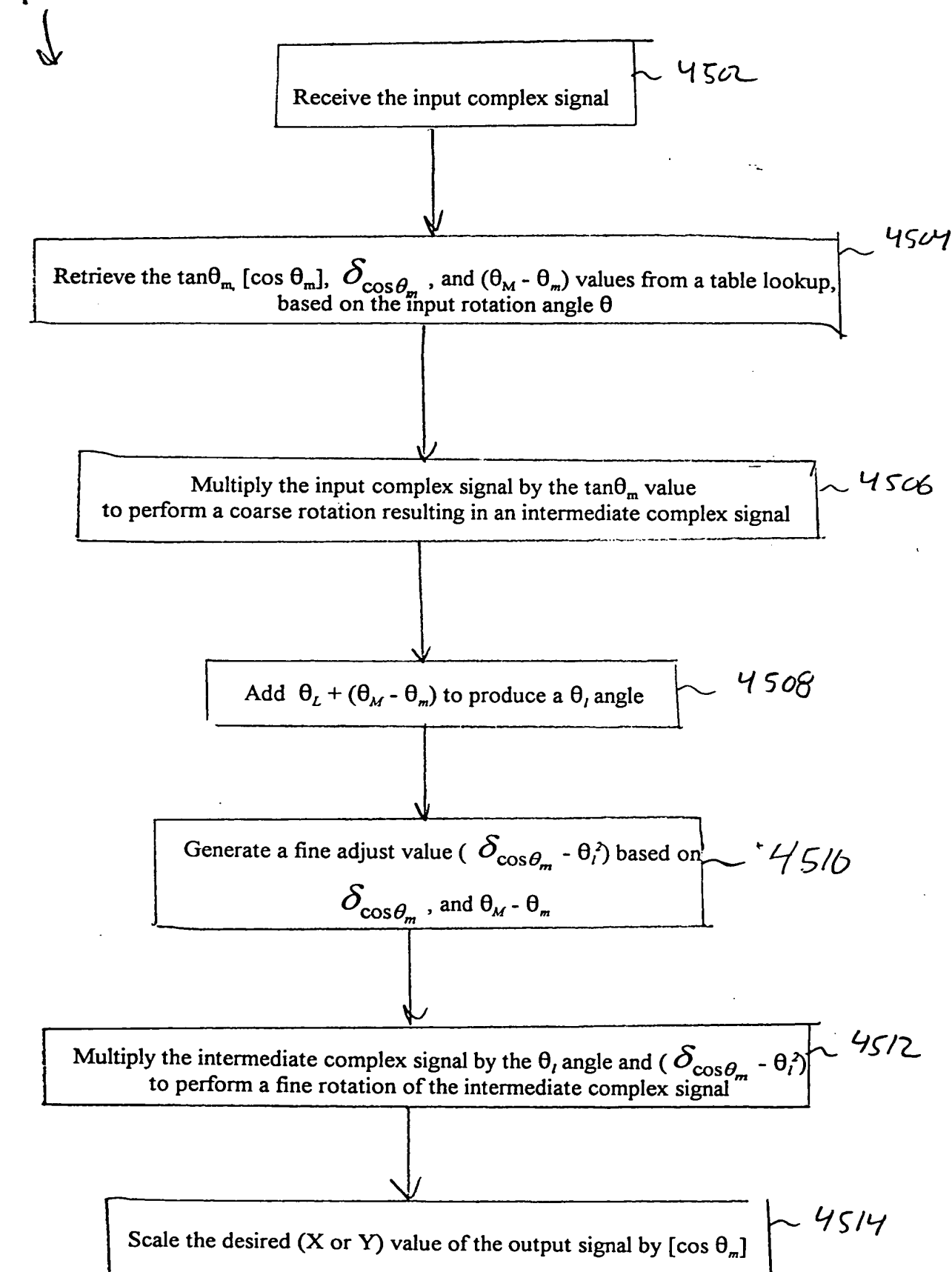


FIG. 45

where the adder is an overflowing accumulator.

4700  
↓

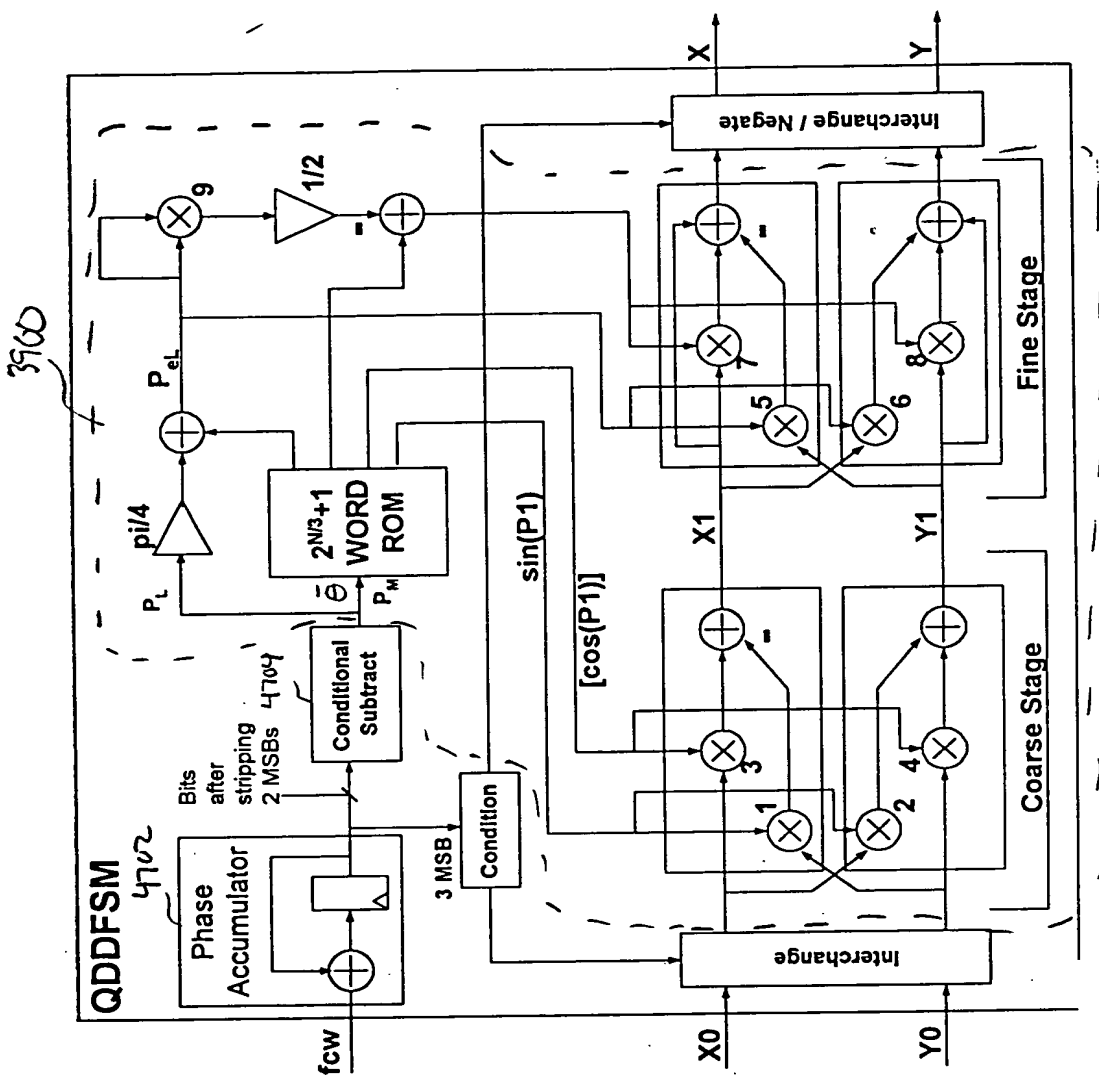


FIG 47

yes →

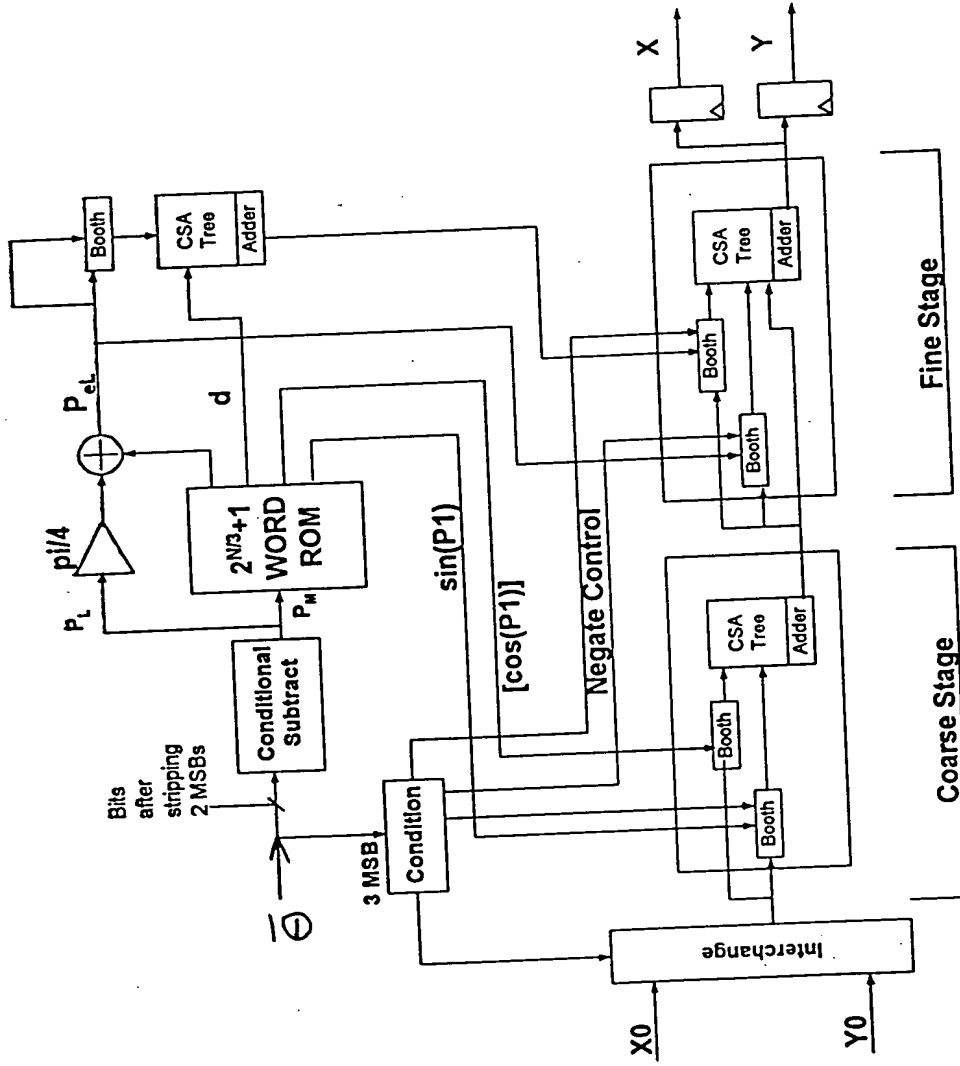


FIG. 4B

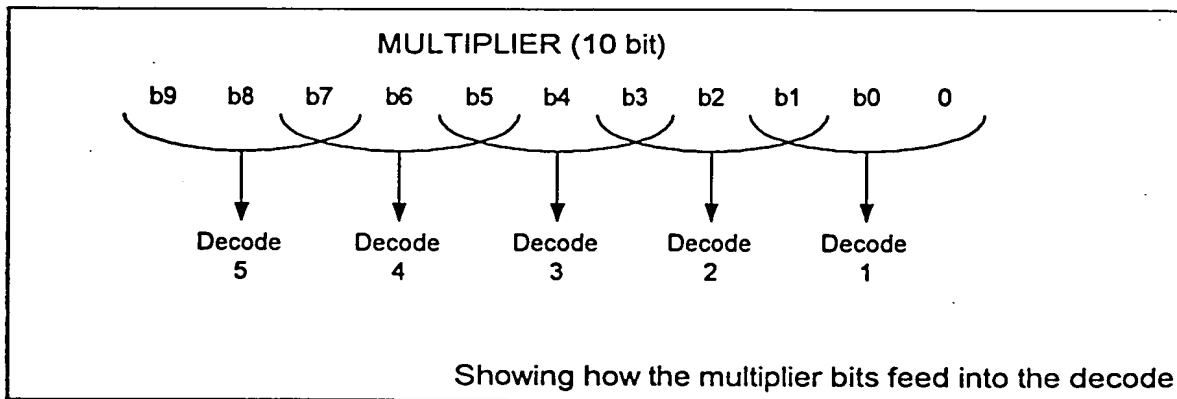
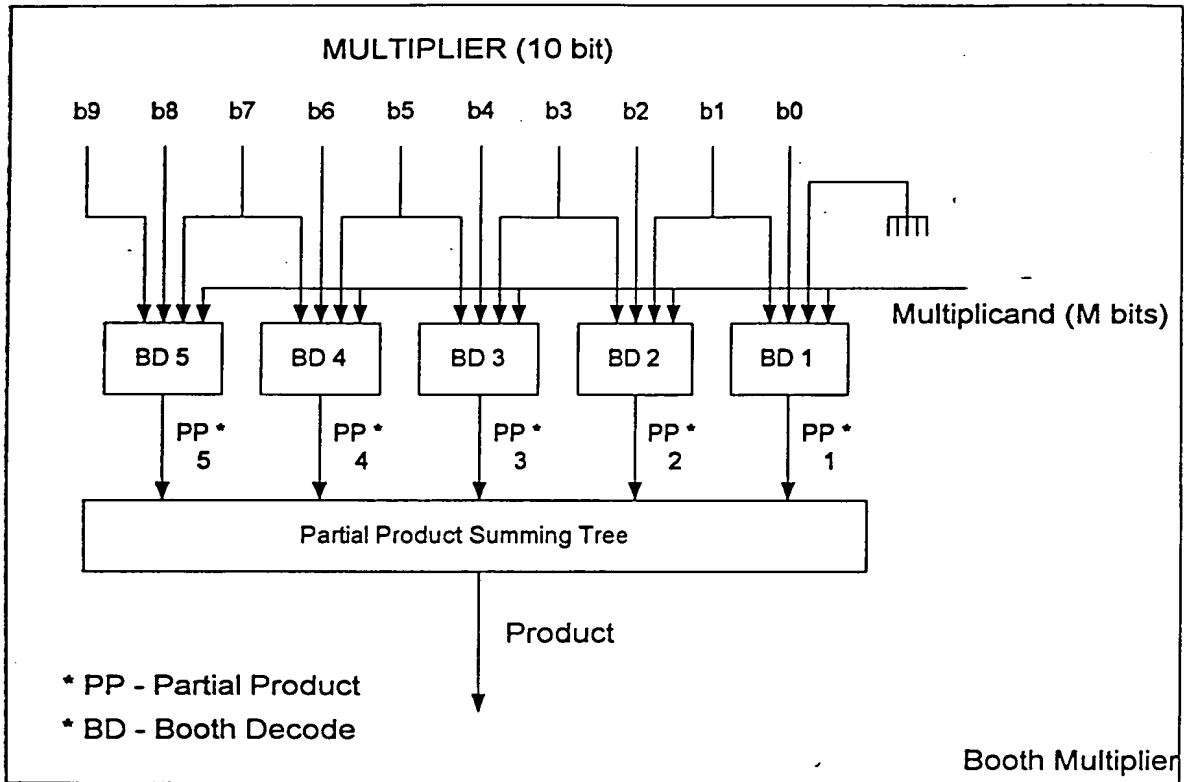


FIG. 49

5000  
↓

Original Booth Table

5002

b2 b1 b0 PP

0	0	0	0*A
0	0	1	1*A
0	1	0	1*A
0	1	1	2*A
1	0	0	-2*A
1	0	1	-1*A
1	1	0	-1*A
1	1	1	0*A

FIG. 50

5100  
↓

Negating Booth Table

5102

b2 b1 b0 PP

0	0	0	0*A
0	0	1	-1*A
0	1	0	-1*A
0	1	1	-2*A
1	0	0	2*A
1	0	1	1*A
1	1	0	1*A
1	1	1	0*A

FIG. 51

5260  
↓

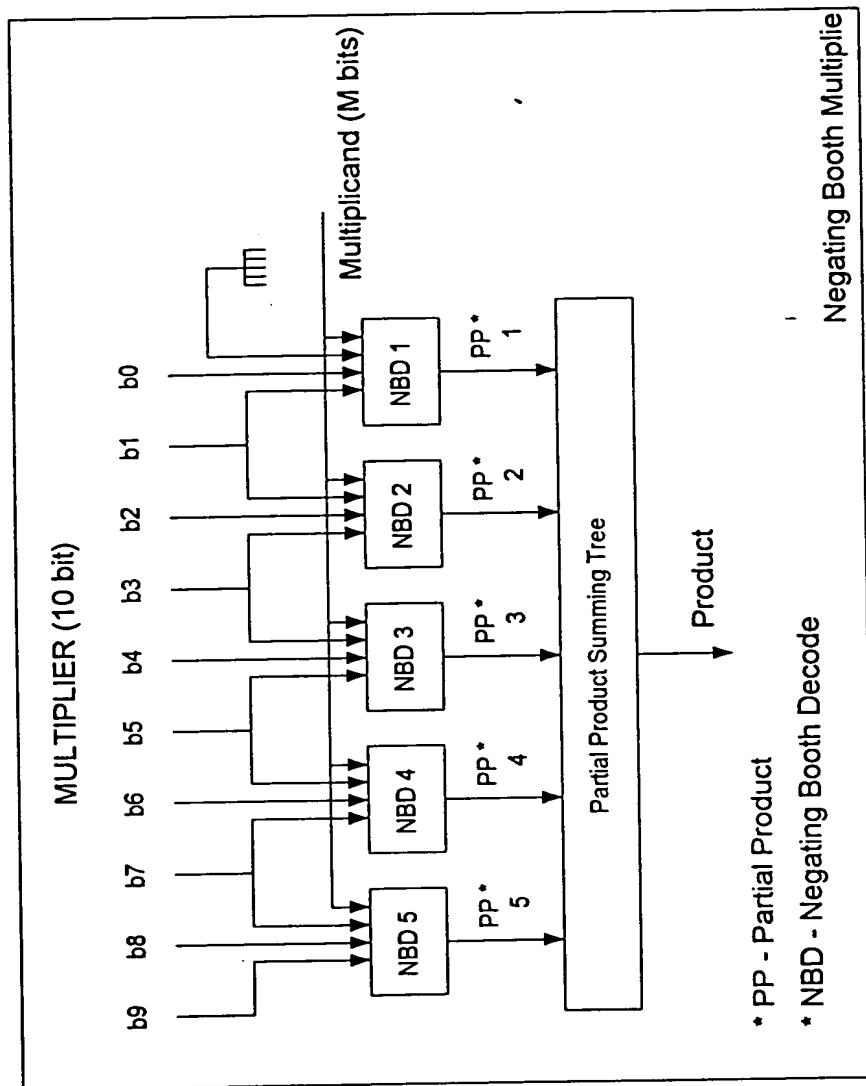


Fig. 52

5300

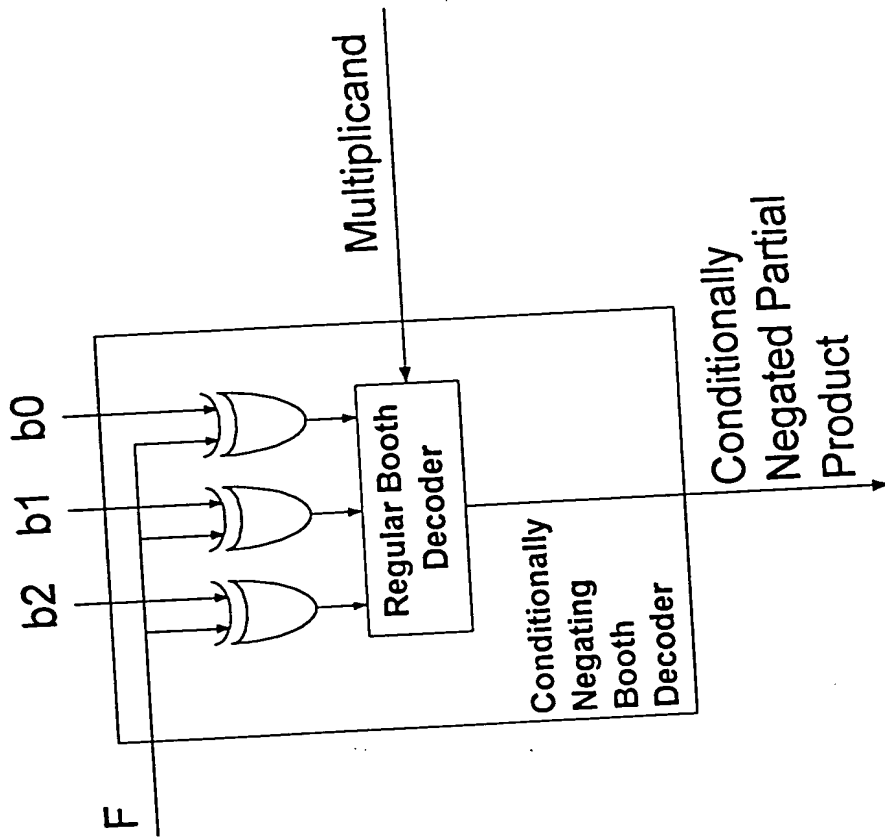


Fig. 53

5406

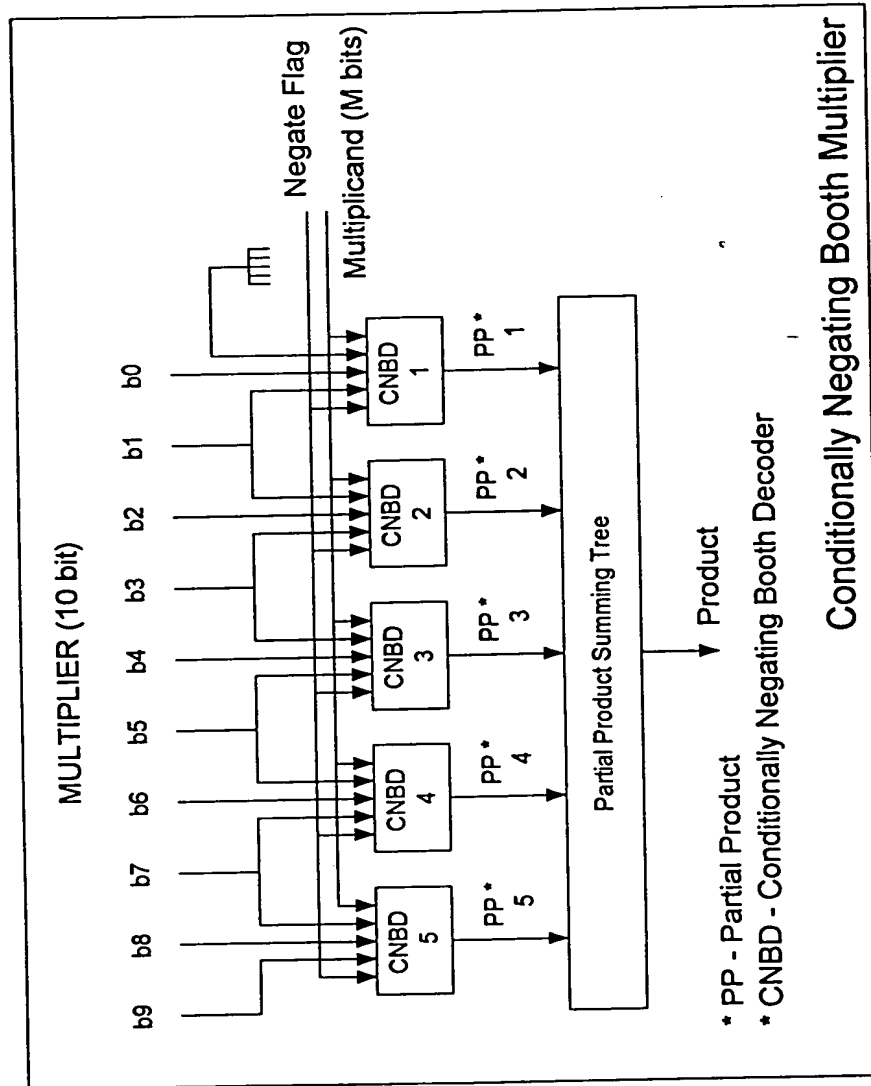


FIG. 54

5500

5502

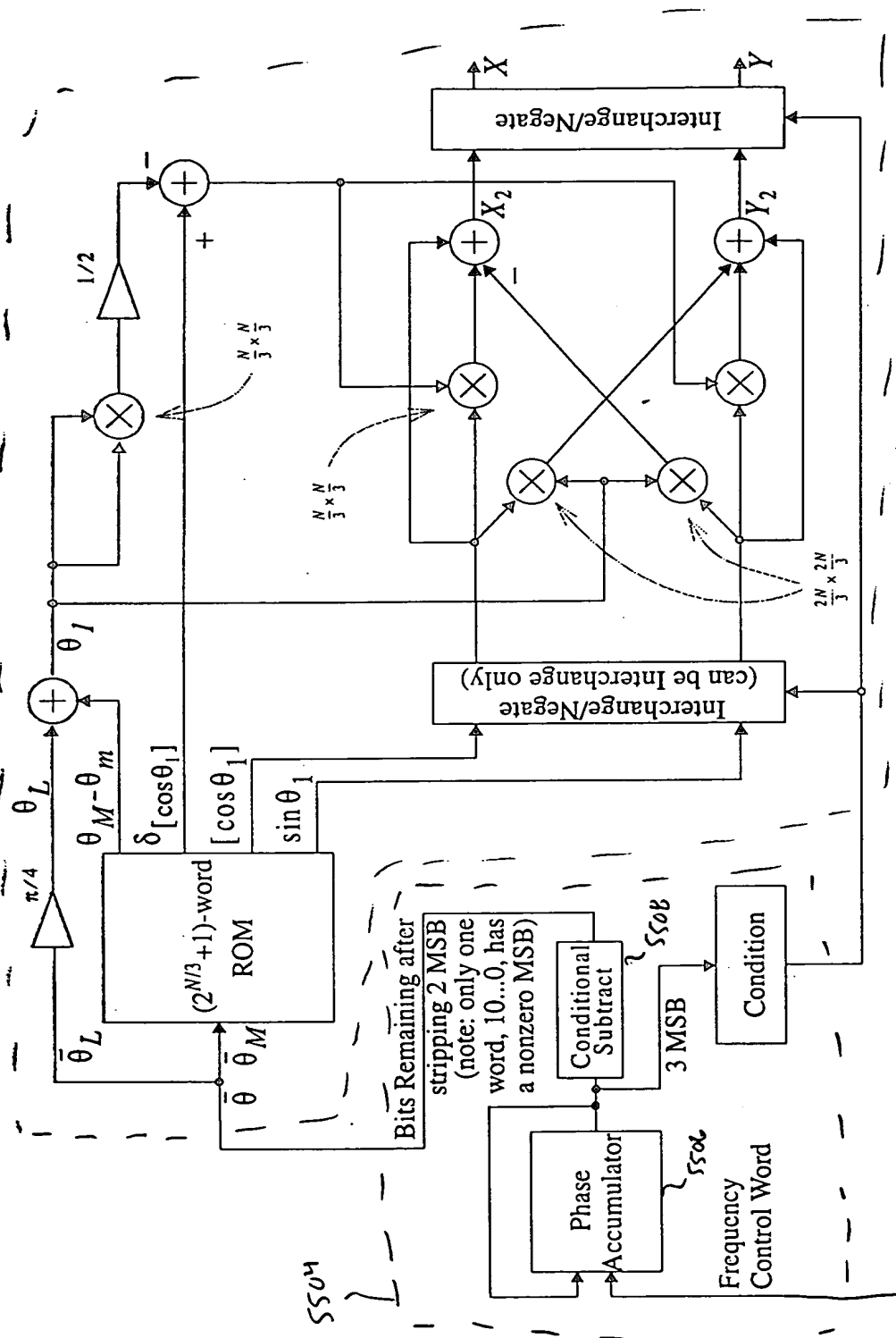


Fig. 55 Angle Rotator Configured as a Quadrature Direct Digital Synthesizer (QDDS).

5600

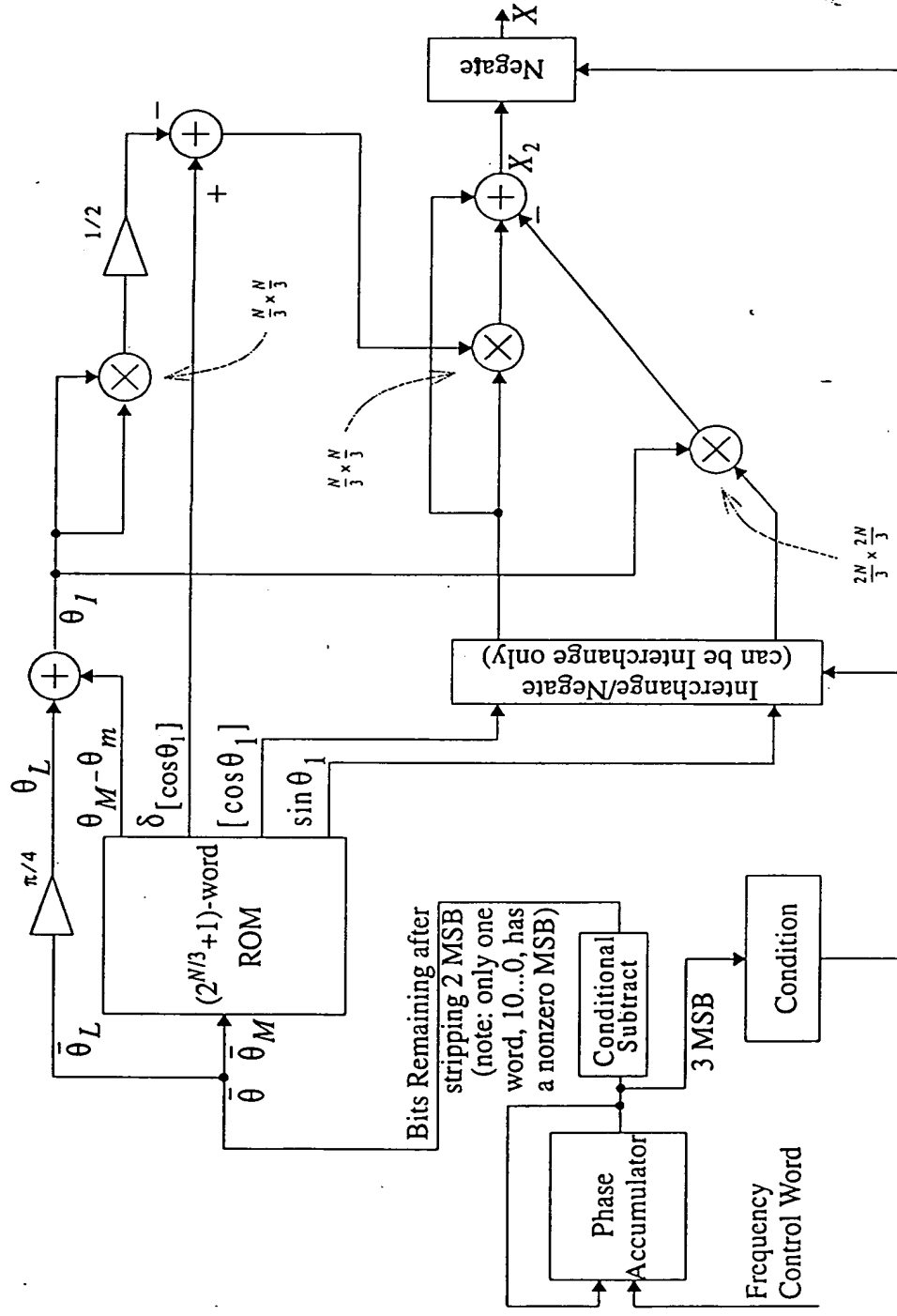


Fig. S6 Angle Rotator Configured as a "Cosine-only" Direct Digital Synthesizer (DDS) {from Fig 37}.

5700

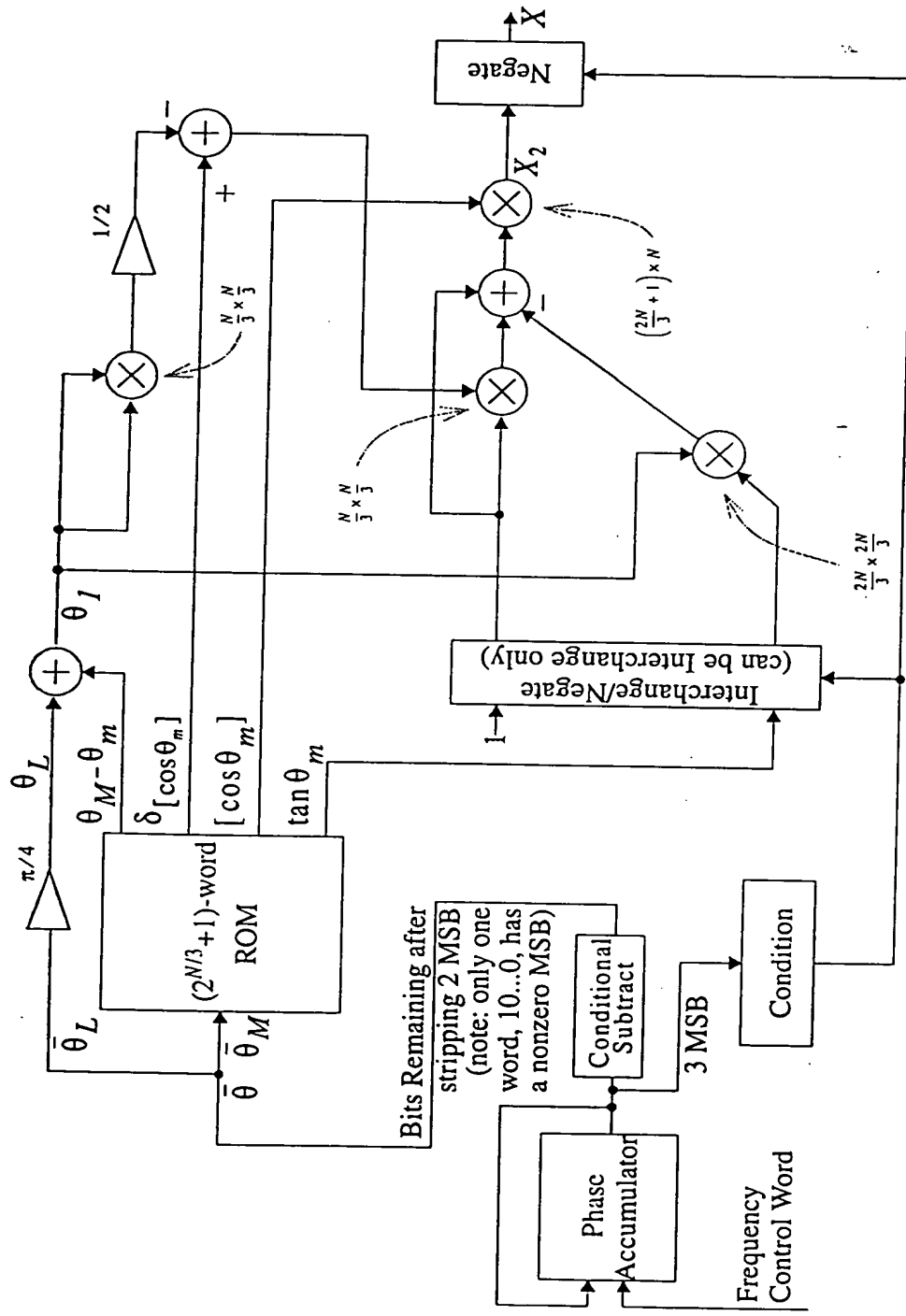


FIG. 57 Angle Rotator Configured as a "Cosine-only" Direct Digital Synthesizer (DDS) {from Fig. 44



FIG. 60 Mean values of the preamble correlator output, for  $\theta = 0$ .

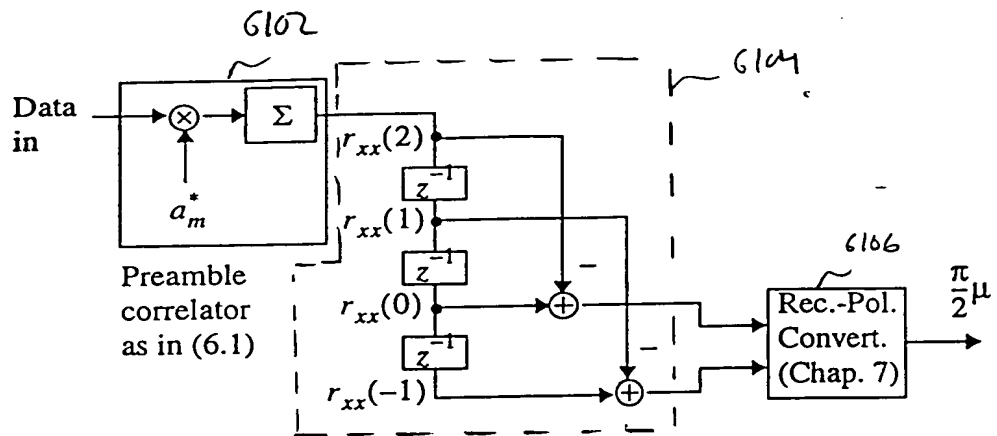


FIG. 610 Preliminary symbol-timing estimation structure.

6200  
↓

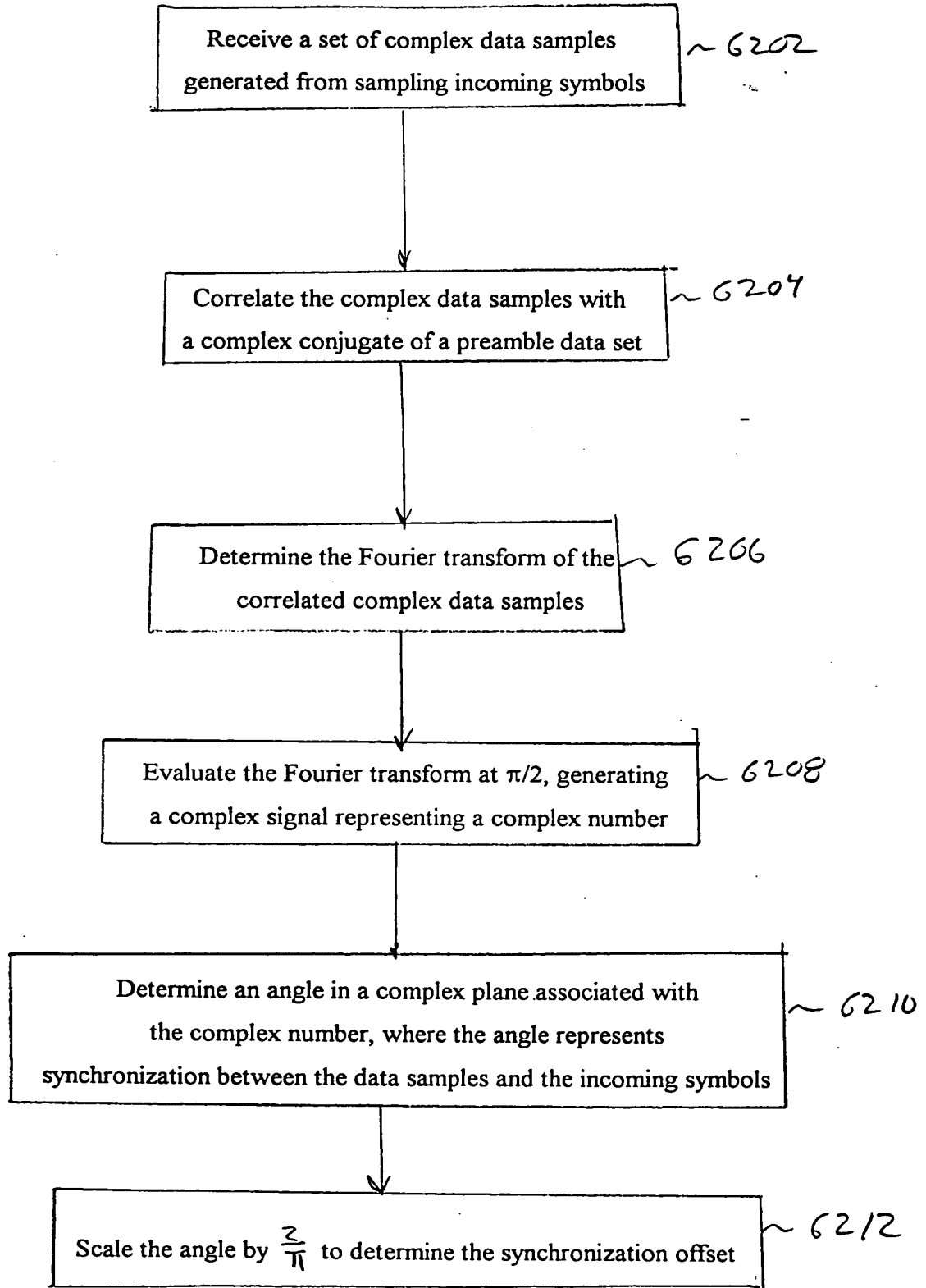


FIG. 62

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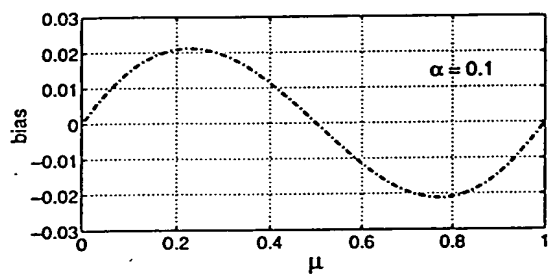


FIG. 63 Bias due to truncation.

6406

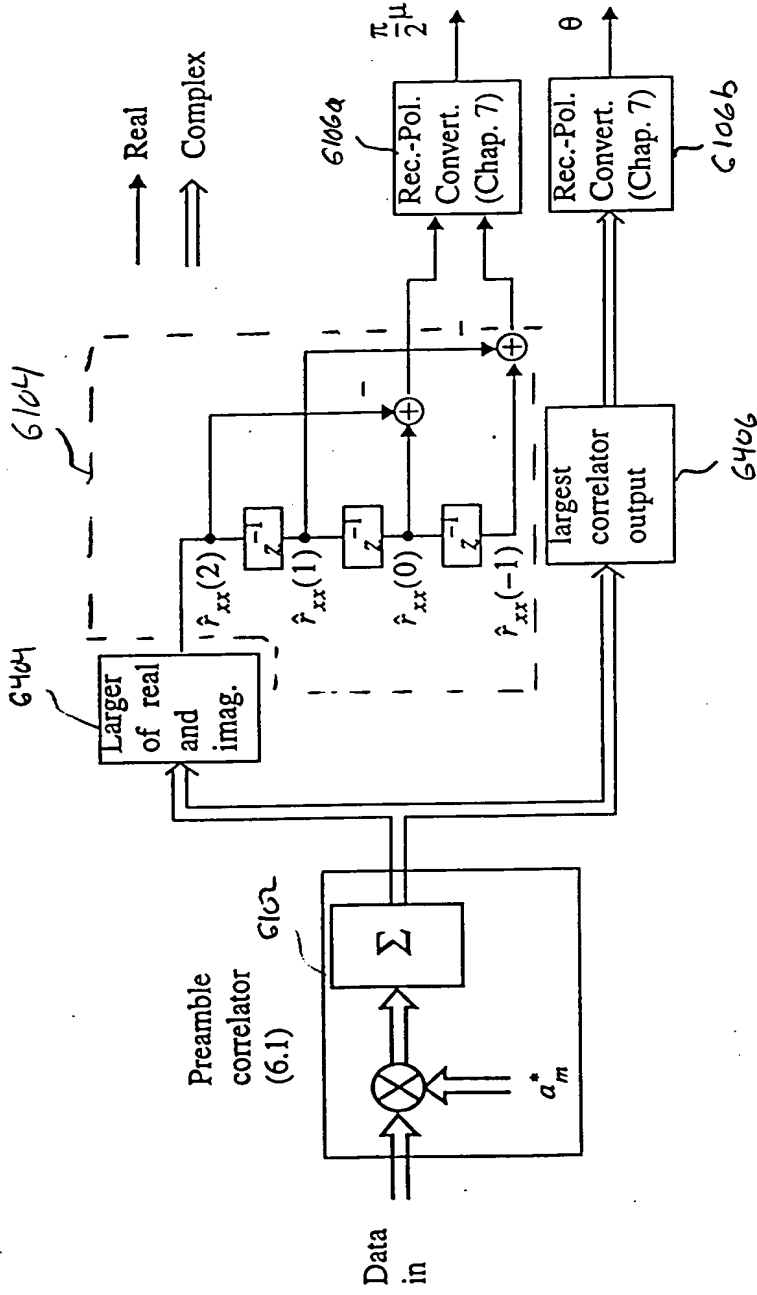


FIG. 64 Structure for carrier-phase and symbol timing recovery.

6500  
↓

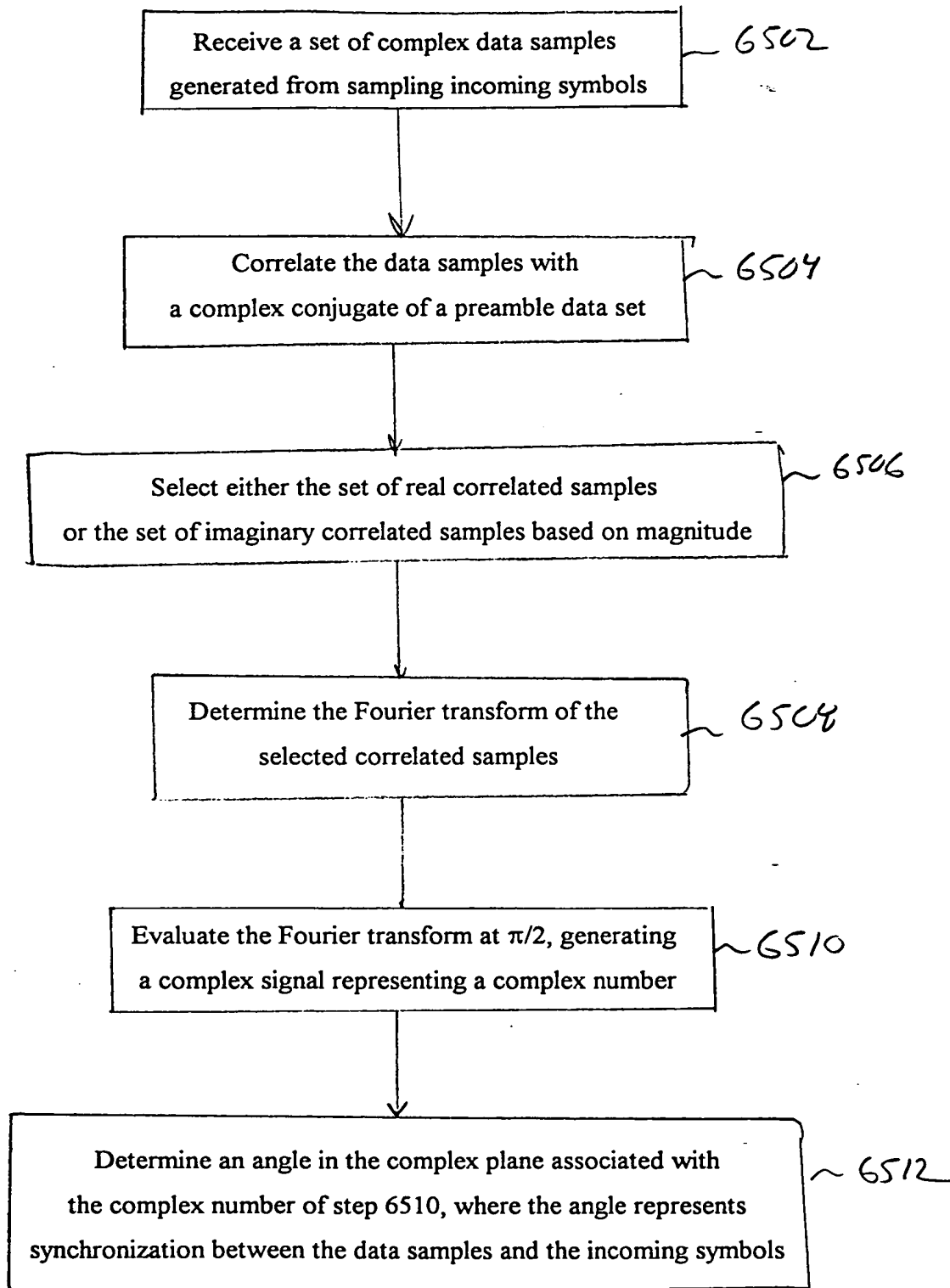


FIG. 65A

6500 (cont.)

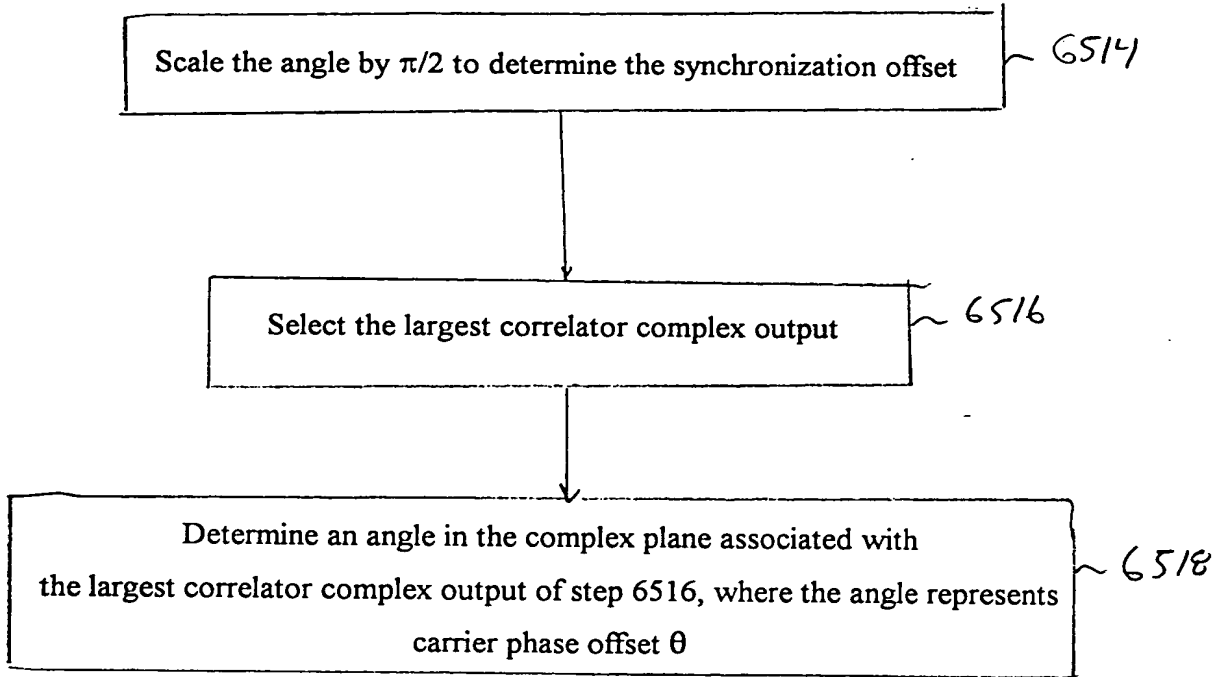


FIG. 65B

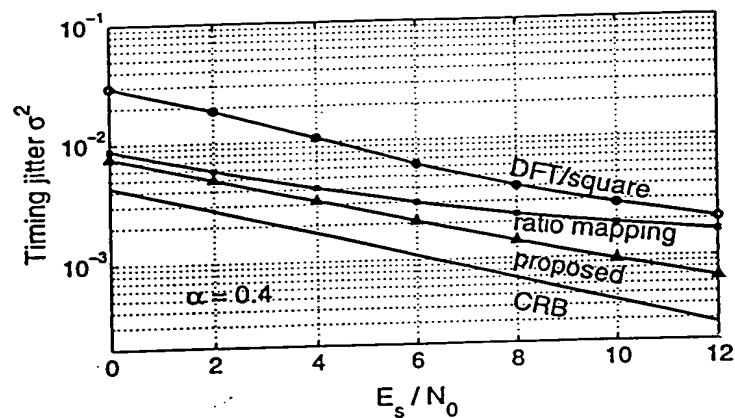


Figure 66: Timing jitter variance,  $\alpha = 0.4$ .

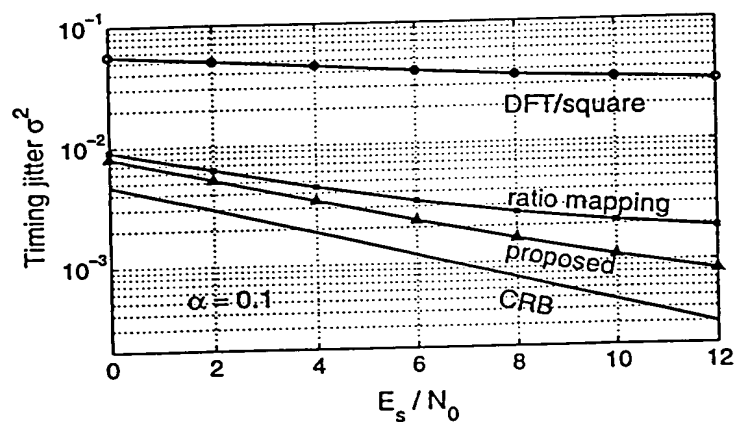


Figure 67: Timing jitter variance,  $\alpha = 0.1$ .

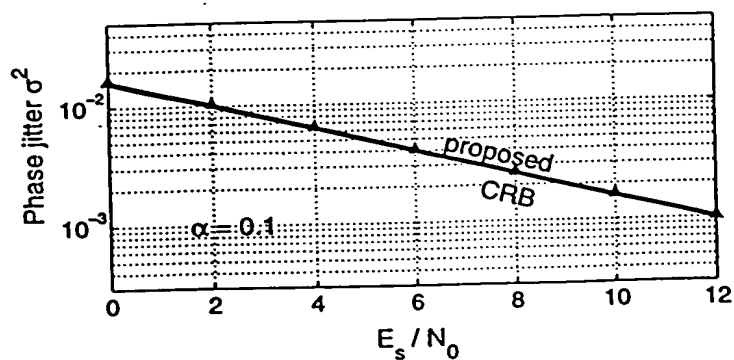


Figure 68: Phase jitter variance,  $\alpha = 0.1$ .

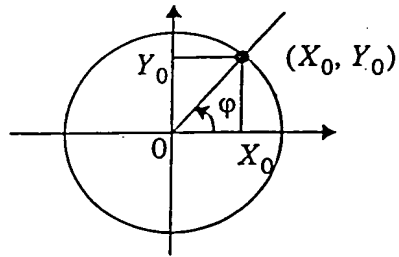


FIG. 67 Cartesian to polar conversion.

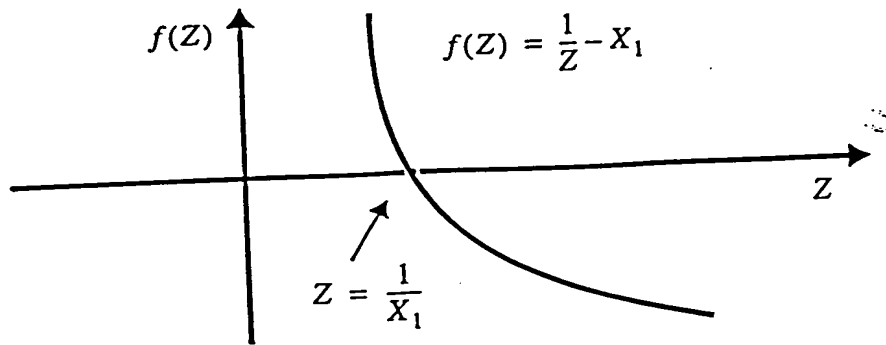


FIG. 70A: Using Newton-Raphson iteration to find  $1/X_1$ .

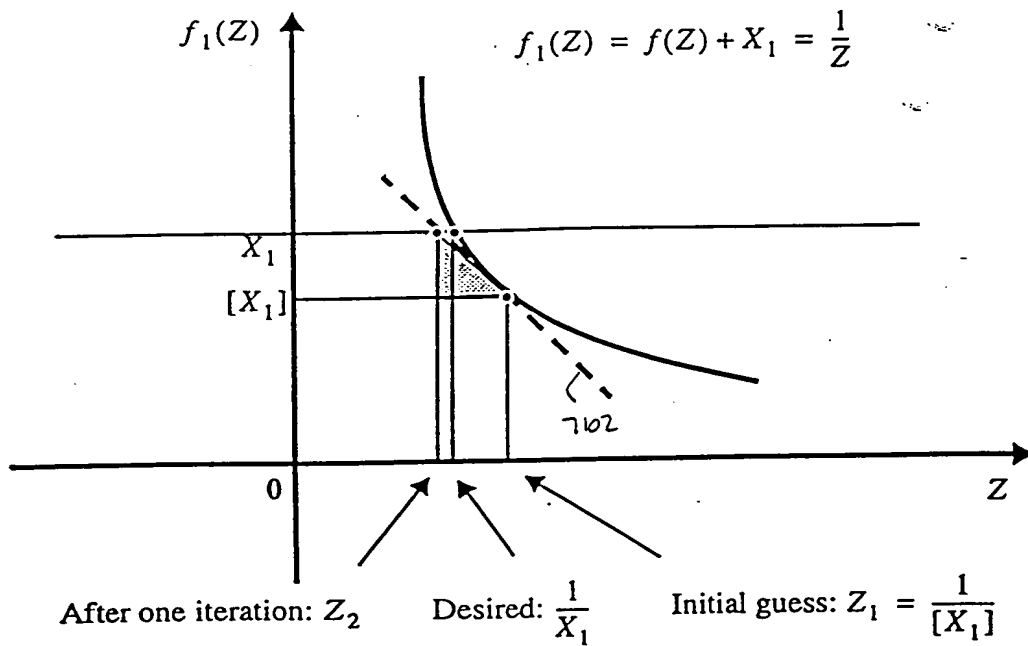


FIG. 70B: One Newton-Raphson iteration.

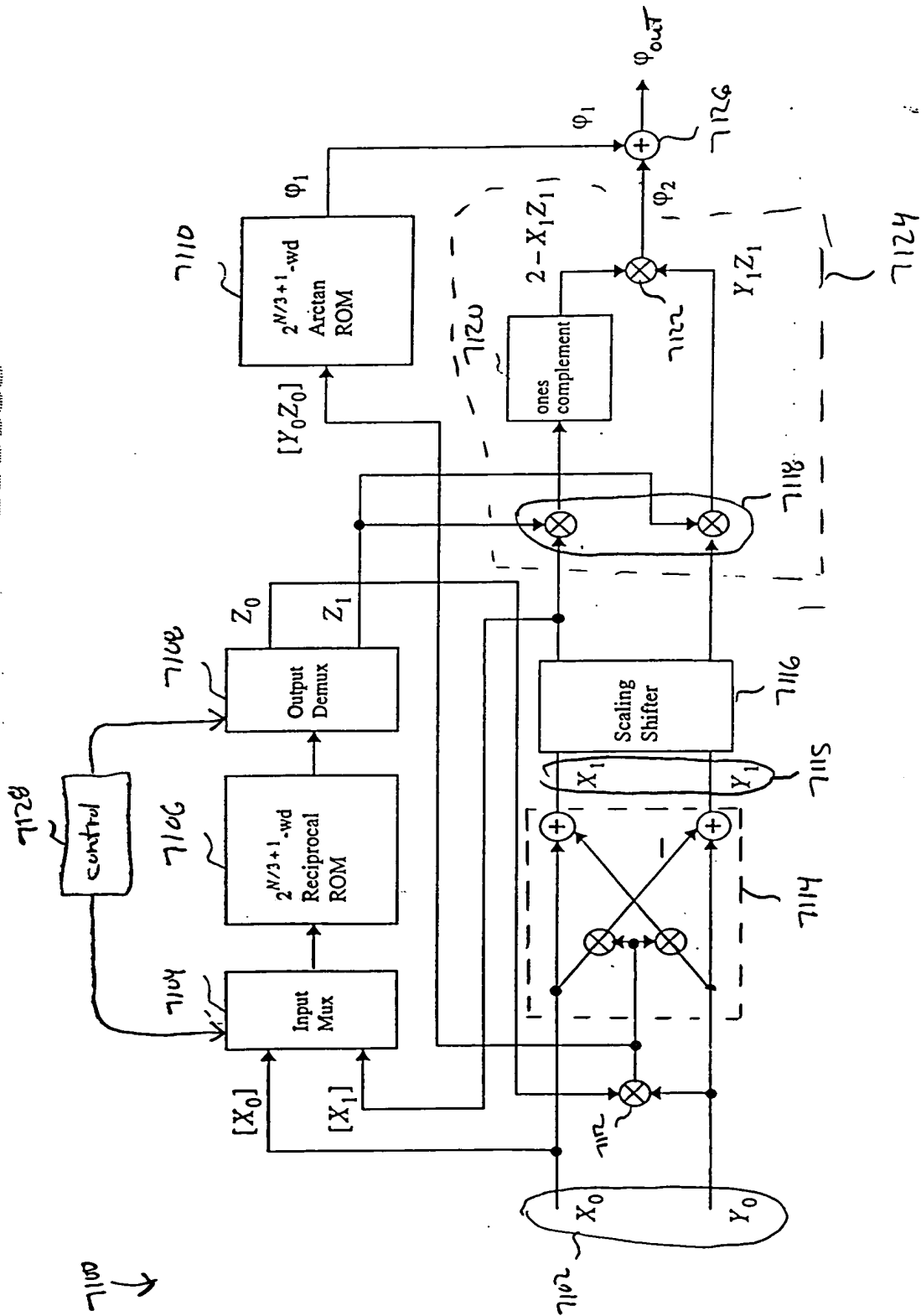


FIG. 71:

09698249 103000

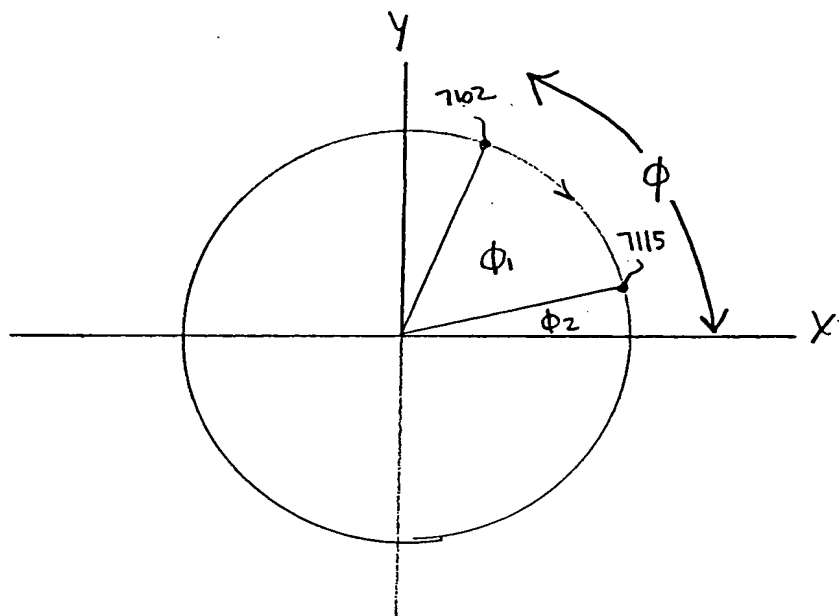
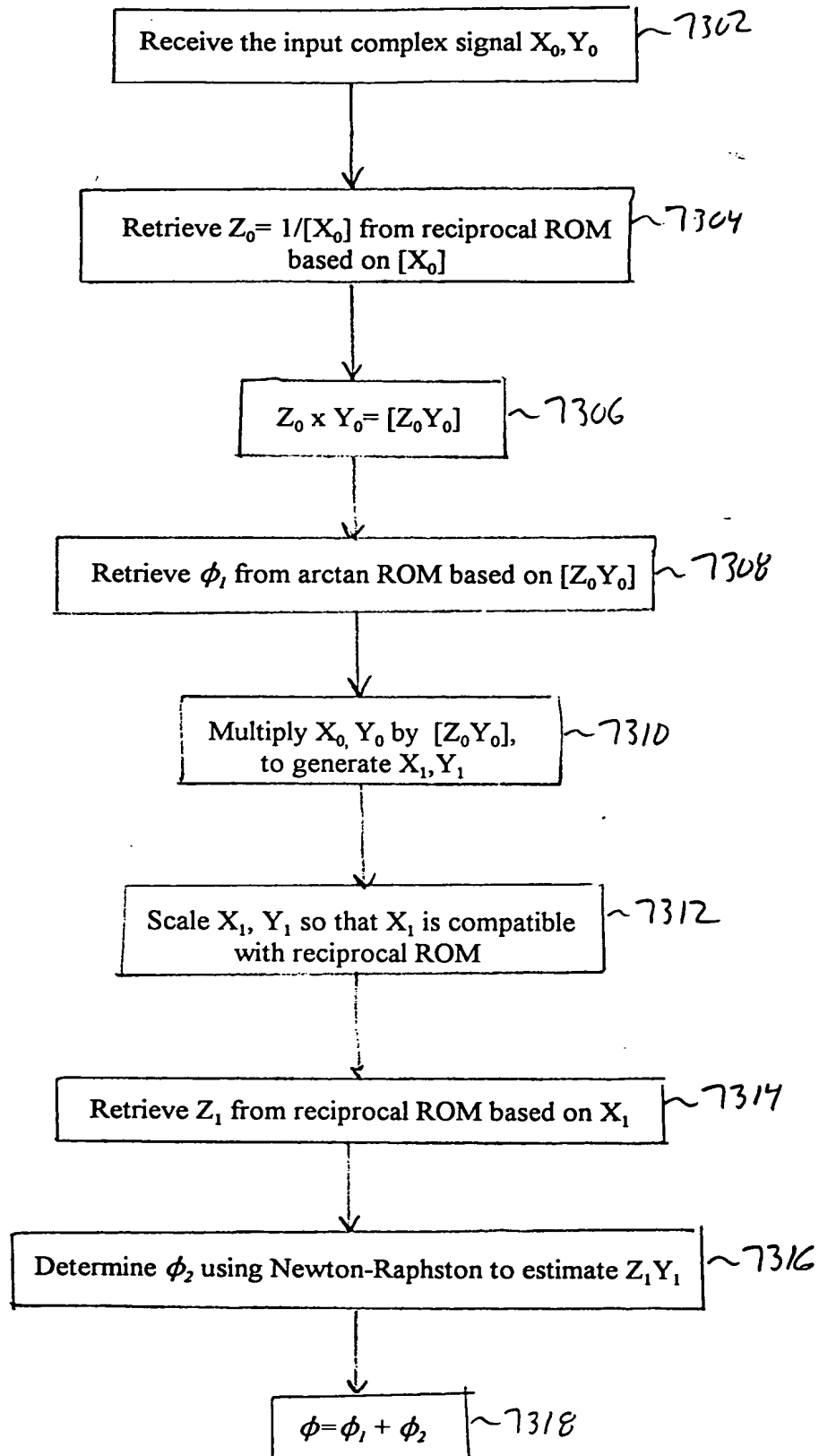


FIG. 72

00000000000000000000000000000000



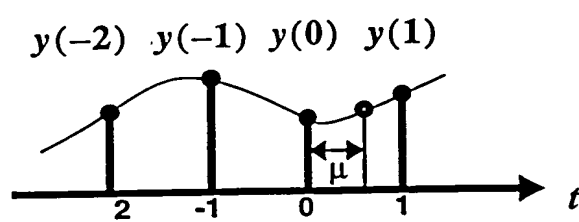


FIG. 74 Interpolation in a non-center interval.

FIG 75B

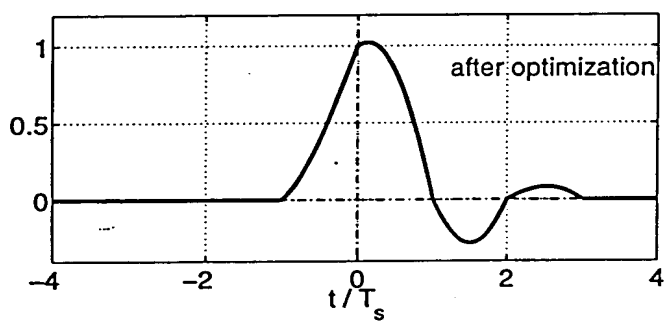
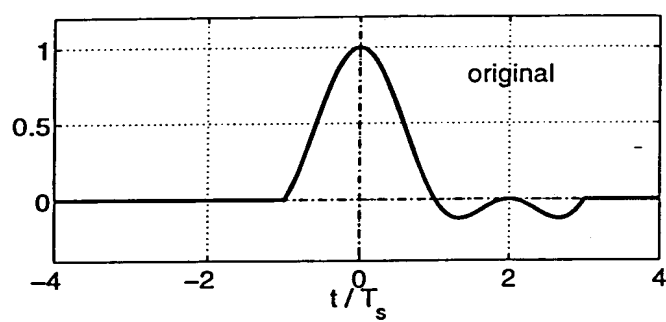


FIG. 75A-B: Impulse responses of the non-center-interval interpolation filter  $A$ , before and  $B$ , after optimization.

FIG. 76A

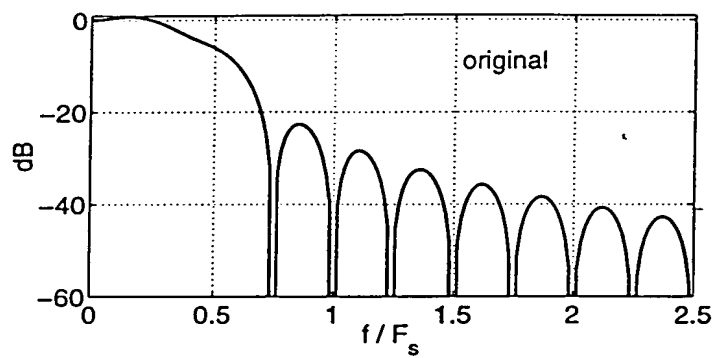


FIG. 76B

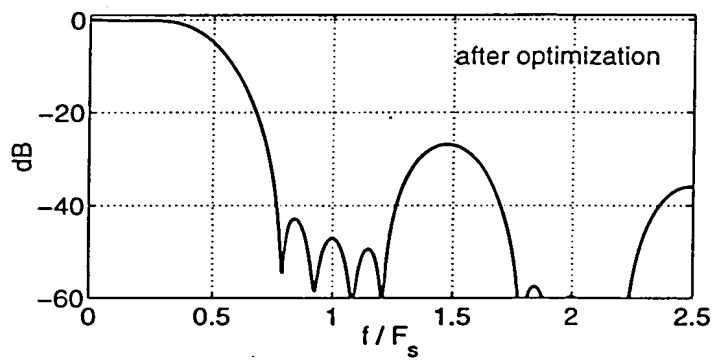


FIG. 76A-B : Frequency responses of the non-center-interval interpolator , before optimization and , after optimization.

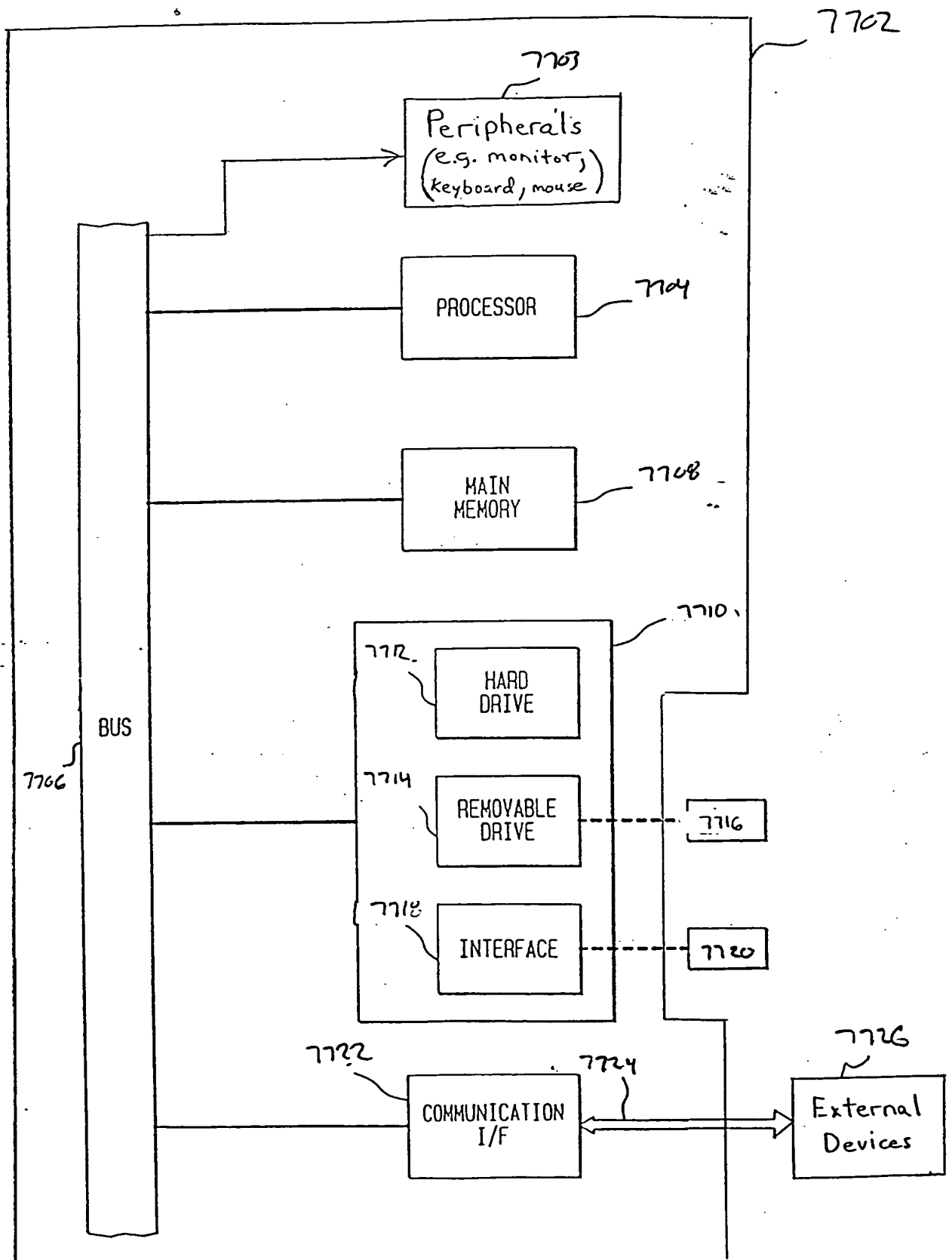
[illegible]

Fig. 77

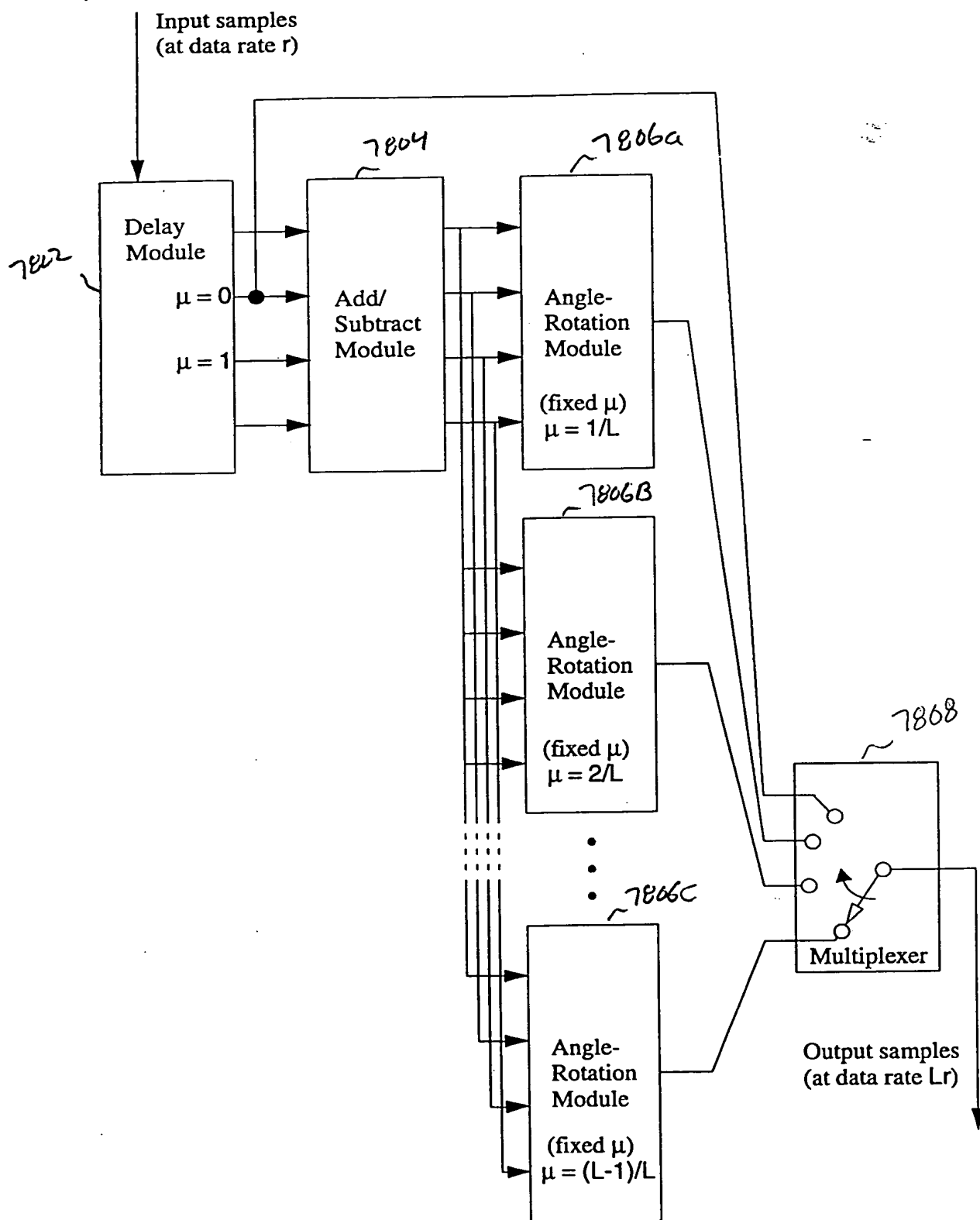


FIG. 78 Data Rate Expansion Circuit.